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PLAN B THESIS

STATISTICAL MODELLING METHODOLOGY FOR THE DETERMINATION OF HABITAT SUITABILITY AND HABITAT PREFERENCES OF THE ENDANGERED FOUNTAIN DARTER

by

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ABSTRACT

The San Marcos and Comal Rivers, located in south Texas, support populations of five Federally listed or endangered species. Both rivers are fed by spring runs which are supplied by the Edwards aquifer which is currently in an overdraft condition. A major reduction or elimination of spring flows is considered a severe threat to the survival of these species. In order to preserve these species, the United States Fish and Wildlife Service (USF&WS) initiated a 5-year cooperative agreement with Utah State University to assess and quantify the instream flows necessary to protect these species.

The research presented in this paper concentrates on the habitat needs and habitat utilization patterns of the fountain darter (*Etheostoma fonticola*) in the Comal River with the goals of generating a habitat occupancy equation, a population density equation, and developing a statistical methodology for handling similar situations. Field data collected on the Comal over a one year period contained information on the physical, chemical, and vegetative environment as well as information on fish species composition and numbers. This data was systematically reduced, normalized, and then analyzed by various statistical techniques including principle component analysis, discriminate functions analysis, multiple regression analysis, and analyses of variance and covariance.

An occupancy equation (presence/absence) was successfully developed with a 78% accuracy rate for the summer season and a 58% accuracy rate for the fall season. A statistically valid population density equation was only developed for the summer season and had a model R^2 of 0.28.

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INTRODUCTION

The San Marcos and Comal Rivers, located in south Texas (Figure 1), support populations of five Federally listed threatened or endangered species. One species is currently listed as endangered. These rivers provide unique habitat as a result of their common source, the Edwards Aquifer. This aquifer is currently in an overdraft state which jeopardizes the flow from the springs which feed these rivers and thus the entire aquatic ecosystem. One of the species, the fountain darter (Etheostoma fonticola) was reintroduced into the Comal River from the San Marcos after going locally extinct in the 1950's due to reduced spring flows. For this reason, as well as other pressures on these ecosystems, the U.S. Fish and Wildlife Service (USF&WS) initiated the San Marcos and Comal Springs and Associated Aquatic Ecosystems Recovery Plan (Aug 1994). One of the major actions required in this plan is to determine the instream flow needs of flow dependent aquatic resources of the Comal and San Marcos ecosystems. As part of this effort, the USF&WS initiated a 5-year cooperative agreement with Utah State University to assist in research on the development and application of multidisciplinary assessment methods for these river systems with the overall goal of quantifying instream flows necessary to protect these unique aquatic ecosystems. A comprehensive study plan (Hardy 1992) was developed in consultation with species experts, local, state, and federal management agencies, and other interested parties within the environmental community which has subsequently been implemented. The scope of work outlined in the study plan focused on research to characterize the physical, chemical, and biological environment within the Comal and San Marcos River

Ecosystems and subsequent development of assessment tools appropriate for evaluation of impacts of alternative flow levels on target species of concern.

This thesis is intended to support elements of this research effort within the Comal River Ecosystem relating specifically to the habitat needs and habitat use patterns of the fountain darter (Etheostoma fonticola). Developing a mathematical representation of suitable darter habitat which can be used in conjunction with instream flow assessment methods also under development will enable the USF&WS to evaluate discharge levels for the springs which optimize the opportunity for species survival and ecosystem protection.

Life History Requirements of the Fountain Darter (*Etheostoma fonticola*)

The amount of knowledge concerning the habitat needs and preferences of the fountain darter is somewhat limited. The USF&WS recovery plan contains a summation of what is known about the species, with the pertinent elements that relate to this thesis summarized below. The fountain darter is a small species of darter occurring exclusively in the San Marcos and Comal Rivers (Figure 1). The species is considered to be the most advanced or specialized of the darters based on an analysis by Bailey and Gosline (1955) and Collette (1962) which showed some of the species traits to be highly influenced by environmental conditions. The USF&WS recovery plan states the following concerning fountain darter habitat requirements:

1) undisturbed stream floor habitats (including runs, riffles, and pools)

2) a mix of submergent plants and mats of filamentous algae, in part for cover

NEW BRAUNFELS WEST QUADRANGLE
TEXAS
7.5 MINUTE SERIES (TOPOGRAPHIC)

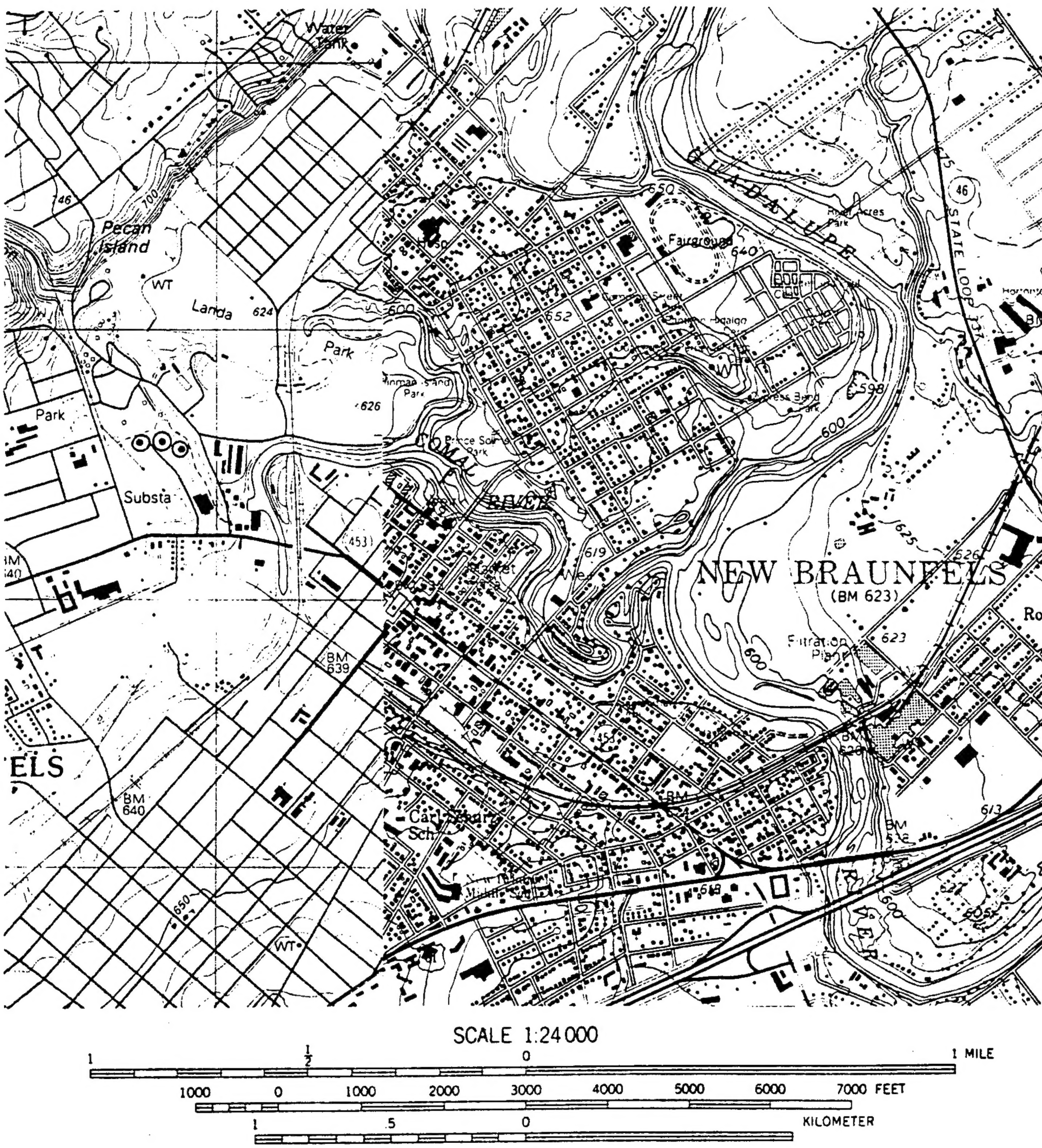

Figure 1. Comal River Study Location

3) clear and clean water

4) food supply of living organisms

5) most importantly, adequate springflows.

Based on field observations, the fountain darter prefers the stream bottom, constant water temperature, and mats of vegetation, most notably, filamentous green algae and the bryophyte Riccia.

Sources of Data

To improve the knowledge of what constitutes suitable darter habitat, members of the USF&WS, the Texas Department of Parks and Wildlife and Utah State University collected extensive field data within the Comal Rivers during four sampling periods (July and November 1993, January and April 94). The river was first photographed aerially using multi-spectral imaging and divided into strata (reaches) based on similarity of channel conditions. Each strata was then divided into uniquely numbered, 10 m^2 cells. Figure 2 shows a typical aerial photograph of the Comal; specifically stratas 8, 5, and part of strata 4 with the grid system imposed. A minimum of ten percent of these cells from each strata were randomly selected for sampling during each period. Sampling was accomplished using a 1m long by 2 m wide by 2 m tall rectangular drop net structure placed into each sampled grid location. Cells with a depth exceeding 2 m were not sampled. The data gathered includes information on the physical and chemical conditions of each grid, amount and type of vegetation, population and species composition of fish, and species composition of invertebrates

present. Invertebrate data was not included in this analysis. Specific information on the methods used to gather this data is contained in the Habitat and Flow Requirements Study for the Comal Ecosystem (Hardy, 1992) which is provided in Appendix 1. The field data collected can be roughly grouped into four categories or attribute types: physical, chemical, vegetative, and fish. The information gathered on each cell is shown in Table 1.

Table 1. Field Data Collected

PHYSICAL	CHEMICAL	VEGETATIVE	FISH
Depth	Water Temperature	Species Composition	Population Numbers
Mean Column Velocity	Turbidity	% Aerial Coverage	Species Composition
Bottom Velocity @ 15 cm	Specific Conductivity	Height Above Bottom	Darter Lengths
Substrate	pH		
	Dissolved Oxygen		

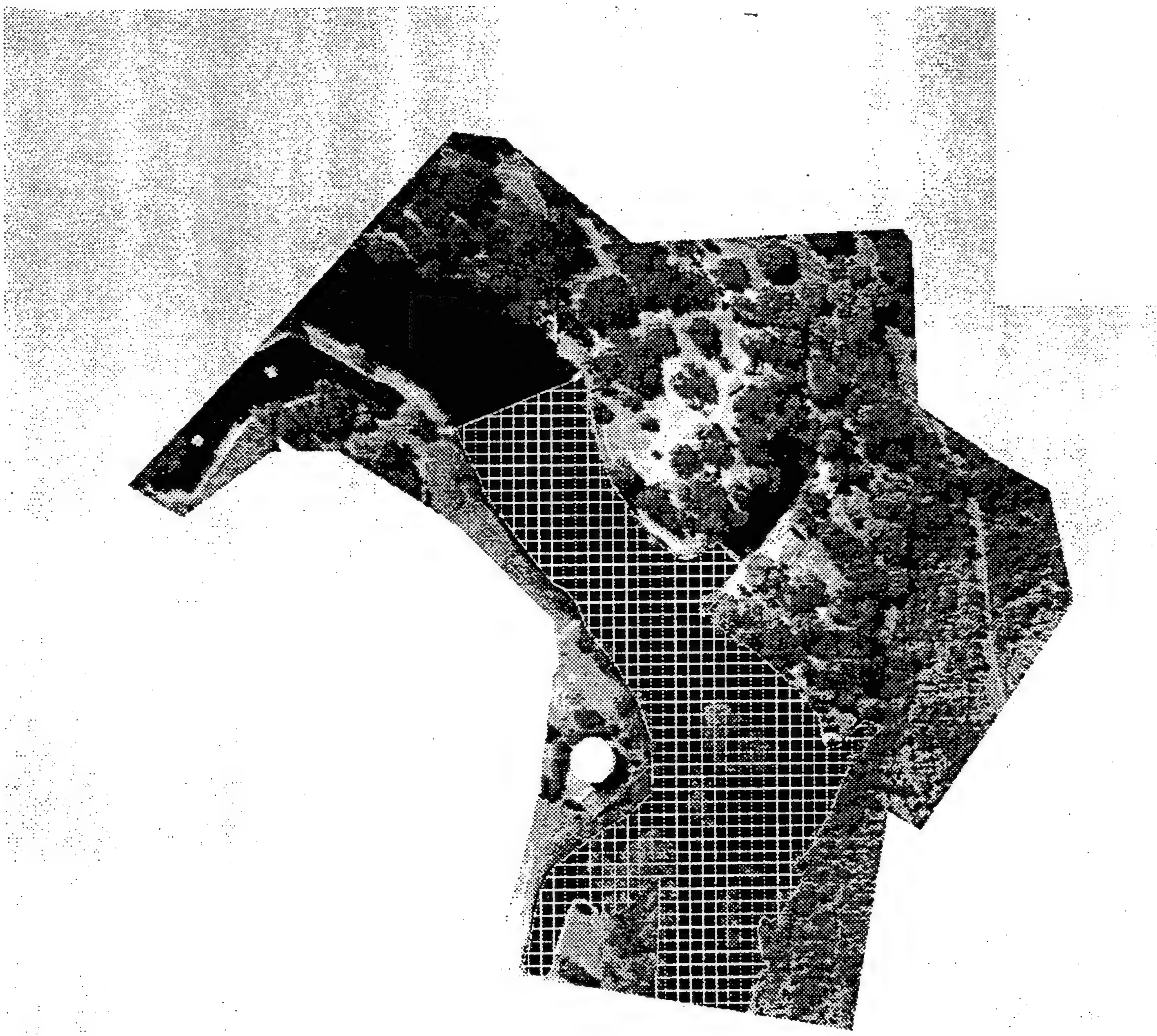

Figure 2. Aerial Photograph of the Comal with Grid Overlay

PROJECT GOALS

The goals of this project are threefold:

1. Develop a logical statistical modeling methodology for the evaluation of this data set and for future applications.
2. Develop a habitat occupancy equation for the Comal River darter.
3. Develop a population density equation.

Accomplishment of these goals will provide the USF&WS with the information it requires to integrate biological criteria with hydraulic and other physical habitat modeling efforts to evaluate various discharge levels which optimize fountain darter habitat within the Comal River ecosystem as well as a methodology for evaluating similar requirements within the San Marcos River Ecosystem.

METHODS OF ANALYSIS

Some of the most common approaches to predicting habitat suitability include the calculation of a Habitat Suitability Index (HSI) and the closely allied Habitat Capability (HC) models (Morrison 1992). The calculated values from these procedures represent the species response to the combination of key variables selected by the investigator. These methods assume that the variables chosen adequately represent a species response to the environment but does not typically provide information on population size. These procedures do not lend themselves to application in this study

as little is known concerning the habitat requirements of the darter and therefore selection of the key parameters required for the procedures would be guesswork.

More powerful statistical techniques commonly used by biologists include principle component analysis (PCA), multivariate regressions, and discriminate functions analysis (Morrison 1992). In particular, multiple regression is the most widely used and misused technique employed by biologists due to its predictive power (Pimentel 1979) . Morrison (1992) states that the primary cause of misinterpretation and misuse of regression is multicollinearity. He further states that multicollinearity is "especially evident in wildlife-habitat analysis" due to the fact that multiple regression is used as an exploratory tool to identify important variables from a larger set of variables. Further errors are introduced by failure to conduct proper residual analysis.

As long as one accounts for the difficulties in using multiple regression techniques to assess biological data, they do provide an exceptional tool for examining complex data sets such as those in this study. The basic techniques employed in this study are discriminate function analysis, principle component analysis, and multiple variable regression. The framework for how these techniques were used to evaluate the field data is shown below in Figure 3.

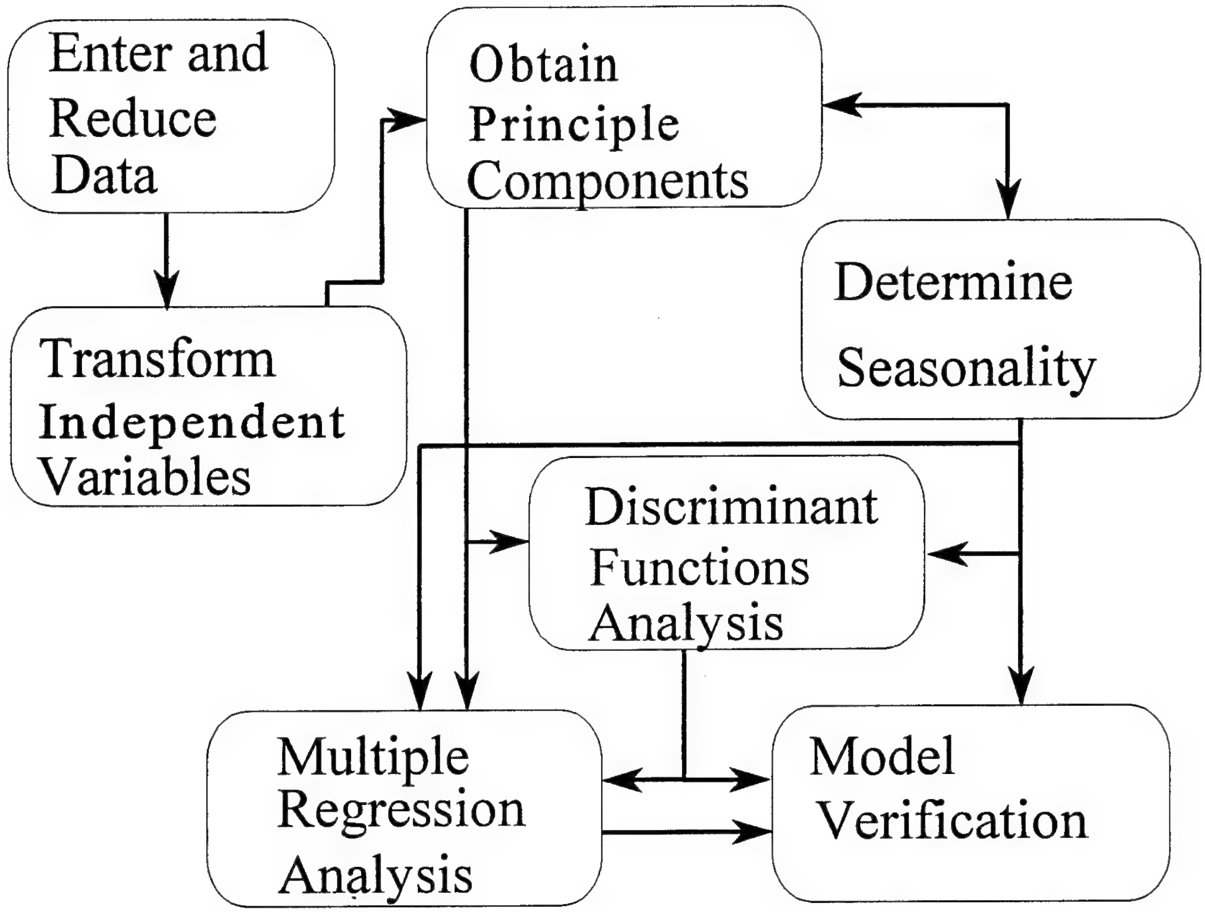

Figure 3. Data Analysis Framework

The raw data was entered into data base files then exported to Borland's Quattro Pro™ spreadsheet files for manipulation. Average velocities were calculated, darter densities tabulated, and any data from those reaches heavilly influenced by spring run imput removed. The data from the strata dominated by spring run flows were removed from the data set as they did not comprise habitat similar in nature to the main Comal River channel. Average velocities, when not collected in the field, were

calculated by taking the numerical average of the velocity measured in the field at 0.2 and 0.8 of the column depth. The absolute value of all velocity measures (measured and calculated) was then taken to remove the directional component. The variable Darter was also created and represents the total number of all darters caught in all the sampling passes conducted on a grid cell. The modified data sets were then exported to SAS Institute Inc.'s SAS™ for further data manipulation and statistical anlyses.

Due to the number of vegetative species (23) and the known importance of vegetation to darters, it was necessary to develop new variables that adequately represented the vegetative community observed in the field while reducing the total number of variables involved. The species of vegetation observed were divided into three broad structural classes. Since each grid contained information concerning the percent of vegetative cover, the dominant species, and the subdominant species of vegetation; the three vegetative community variables are also needed to adequately reflect the true information provided by the raw variables. To accomplish this, a 75%/25% split of total cover was used to assign percentages to dominant/subdominant vegetative cover. When no subdominant species was present, all cover was assigned to the dominant species. The total vegetative cover for a grid cell is composed of the sum of the three vegetative communities. The species included in each vegetative community are shown in Table 2.

Table 2. Plant Species Composition of Vegetative Communities

COMMUNITY 1	COMMUNITY 2	COMMUNITY 3
Riccia fluitans	*Vallisneria americana*	*Ludwigia repens*
Cambomba caroliniana	*Sagittaria platyphyla*	*Nuphar luteum*
Utricularia gibba		*Ceratopteris thalictroides*
Amblystegium riparium		*Sagittaria playtphyla*
Rhyzoclonium		*Hydrocotyle*
unidentified moss		chara species
algae, various species		*Potamogeton*
		Justicia americana
		Eleocharis
		Rorippa n-aquaticum
		unidentified grass
		Colocasis esculenta
		Polygonum
		unidentified iris/flag

Finally, two categorical variables were assigned to each sampling location. Present (1 or 0) indicates whether darters were present or absent in any sampled cell while Period (1=july,2=oct, 3=jan, 4=april) associates the site with a sampling season. The content and structure of the analysis files used is shown in Appendix 2. The actual files are stored on the 3.5 inch diskette accompanying this document.

The first step in the analysis following data entry was to conduct transformations of the independent variables to achieve as nearly as possible a normal distribution for each. The requirement for multivariate normality of the independent variables is

paramount for the successful application of principle components analysis and discriminate functions analysis. SAS™ incorporates a number of numerical and graphical normality tests into its univariate procedure. The measures considered during testing of the variables during this study were Shapiro and Wilk's (1965) W-statistic and normal-probability plots. For the W-statistic, a value of unity indicates a perfectly normal distribution. The normal-probability plot graphically compares the observed quantiles for a given variable against the corresponding quantiles for a theoretical Gaussian distribution with the same mean and standard deviation. Departures from the diagonal indicate deviations from the normal distribution. The values of the W-statistic for the raw data are presented in Table 3.

Table 3. Normality Test Results (W) for the Raw Data (All Seasons)

VARIABLE	W	VARIABLE	W
pH	0.969	Velocity-Bottom	0.526
Depth	0.969	Velocity-Average	0.605
Temperature	0.867	Veg Community 1	0.563
Dissolved Oxygen	0.975	Veg Community 2	0.351
Specific Conductivity	0.692	Veg Community 3	0.747
Darter Density	0.594		

Based on the W statistic, data transformations were necessary for all variables except ph, depth, and dissolved oxygen. The shape of the normal-probability curve indicated which direction to transform the data (positive or negative skew) as well as whether a transformation was even likely to work. Transformations were expected to work on all variables except the three vegetative communities. The plots for these variables

indicated multi-modal distributions which cannot be normalized via data transformations. The multi-modal nature of these variables may be attributed to the manner in which they were derived. Each is a function of the field estimation of percent vegetative cover based on ocular estimates by the field crew. The estimates were much closer to categorical (0,25,50, 75, 100%) than continuous. However, it was necessary to treat them as continuous variables in order to use them in the analysis.

The results of the data transformations on univariate normality are presented in Table 4. The transformations were used on the entire data set first then on each individual sampling period to ensure that they remained valid. The mean value of W for the four periods as well as the associated standard deviation is also included.

Table 4. Normality Test Results on Transformed Data

VARIABLE	W Whole	W July	W Oct	W Jan	W April	W AVG	S.D.$_a$
$\log_{10}$ (avg velocity)	.959	.954	.965	.956	.954	.957	.004
$\log_{10}$ (darter + 1)	.850	.864	.787	.871	.860	.845	.034
temperature^3	.951	.953	.741	.941	.952	.897	.090
spec. cond$^{-3}{}_b$	.884	.651	.756	.745	.882	.758	.082
$\log_{10}$ (bottom velocity)	.907	.890	.944	.906	.888	.907	.022
arcsin(sqrt vc1)$_c$	.627	.625	.593	.644	.690	.638	.035
arcsin(sqrt vc2)$_c$	.370	.375	.297	.488	.287	.362	.080
arcsin(sqrt vc3)$_c$	.785	.782	.782	.769	.805	.785	.013

a. S.D. - Standard Deviation
b. spec. cond. - specific conductivity
c. vc - vegetative community

The selection of the arcsin of the square root of the vegetative communities seemed the most appropriate transformation as the data reflects percentages from a non-

normal, possibly binomial, distribution. Zar (1984) states that this transformation yields a nearly normal distribution for percentages from binomial data. While this turned out not to be the case for this data set, it did yield marginal improvement in the value of W.

Once the independent variables were transformed, Principle Components Analysis (PCA) was conducted on the whole data set as well as for each of the seasons. The components obtained in this analysis represent linear combinations of the transformed independent variables that account for the maximum variation in the data. Each vector component exhibits the characteristic of being orthogonal to the other vector components in the n-dimensional space being explained which removes concerns about correlation and multicollinearity.

The next step in the analysis was to determine if the data set could be treated as one data set or broken down according to sampling periods due to variations between seasons. An analysis of variance (ANOVA) was conducted on the principle components obtained for the whole data set (all seasons) as well as the transformed independent variables. The results of this analysis determined how the data was grouped for all subsequent analyses.

Following the ANOVA of seasons, two presence/absence models describing suitable darter habitat were developed for each season observed using discriminate functions analysis (DFA). The first model consists of the transformed independent variables while the second is comprised of principle components. The occupancy models were evaluated against the observed data as shown in Table 5.

Table 5. Occupancy Model Evaluation

	True Distribution of Fountain Darters	
Model Prediction	Species Present	Species Absent
Present	Correct	Type I Error
Absent	Type II Error	Correct

Morrison (1992) states that Type I errors may occur due to incorrect sampling methods, strategy, or timing; the species is inherently rare and does not occupy all suitable habitats; or the model overstated the value of a set of conditions or missed a detrimental condition. Type II errors occur due to species wandering, sampling design, or the model did not include a vital environmental parameter.

The basic approach to the problem of generating a population density equation was to use multiple regression anlysis on both the untransformed raw data and the principle components for each season with observed darter populations as the response variable. Two variations of the original data set were modeled. The control technique was a traditional multiple regression using the entire unmodified data set for each season. The experimental technique was a two-step hierarchical approach (Cavalli and Crowl, in review) which attempts to account for the assumption that there exists suitable habitat that is not occupied by darters and to include this unoccupied habitat in a regression model predicting population density. This technique, and the focus of this study, was to attempt a regression using all occupied habitats plus only those vacant habitats that were mathematically determined to be suitable for the fountain darter. This method employs the equations predicting presence/absence from the DFA analysis to predict which of the vacant habitats should have contained darters.

These sites are included with the occupied sites in the regression analysis. Sites which did not have darters observed and were also predicted not to have darters were excluded from the regression analysis. The modified data set will be referred to as the DFA-modified data for the period in question in all subsequent discussions. All regression efforts were analyzed for the effects of multicollinearity as well as normality of residuals to insure that the basic mathematical assumptions of the model employed were met.

The final step in the analysis was to validate the equations generated against any subsequent sampling periods that were considered statistically the same according to the ANOVA previously accomplished. The presence/absence equations were validated using a contingency table to generate chi-square values. If the chi-square value generated is less than the critical chi-square value, then the null hypothesis was not rejected and the populations were considered indistinguishable; the equation holds for both sampling periods.

Validation of the population density equations was more complex. First the variables selected in the step-wise selection procedure were used in a regression on the predictor data set. The regression equation generated was used to generate predicted values of darter density for both the predictor data set and the test data set. The predictions were then regressed against actual darter density for each period to obtain R^2 values with the same degrees of freedom for each. Finally, the data sets were combined and an analysis of covariance (ANCOVA) was conducted to evaluate the significance of the sampling period and the interaction between sampling period

and the model prediction.

RESULTS and DISCUSSION

Seasonality

Following data transformation, principle components were obtained for the combined data set (all sampling periods) for use in a determination of seasonal variation. Five principle components were considered significant and included as the derived independent variables. The significance criteria used was that the eigenvalue for a given component must have a value exceeding unity which indicates that the associated eigenvector explains more variation than a single variable by itself.

Once the principle components were obtained, an ANOVA was performed for each continuous variable and each component against the categorical variable Period. The seasonal variation in each variable is shown in Table 6. Seasons with the same letter are considered to be not significantly different at α=.05 level.

Table 6. Analysis of Seasonal Variation

	SAMPLING PERIOD					SAMPLING PERIOD			
VARIABLE	JUL	OCT	JAN	APR	VARIABLE	JUL	OCT	JAN	APR
pH	B	C	B	A	$\arcsin(vc1^{0.5})_a$	A	A	A	A
depth	A	B	B,C	C	$\arcsin(vc2^{0.5})_a$	A,B	B	A	A,B
$temperature^3$	A	C	C	B	$\arcsin(vc3^{0.5})_a$	A	A	A	A
Dissolved O_2	C	A	A,B	B	prin comp 1	B,A	A	C	B,C
SC^{-3}_b	A	C	D	B	prin comp 2	A	B	B	B
$\log_{10}$ (avg vel)	A,B	A	B	A,B	prin comp 3	A	B	C	A
$\log_{10}$ (bot vel)	A	A	A	A	prin comp 4	A,B	B	B	A
$\log_{10}$ (darter+1)	A	B	A	A	prin comp 5	A	A	A	A

a. vc - vegetative community
b. sc - specific conductivity

Because PCA's are orthogonal (uncorrelated), experimental error elevation was not a problem.

Based on this analysis, the data set was divided into two seasons: a summer season consisting of the July and April sampling periods and a fall season consisting of the October and January sampling periods. Acknowledging that the test was inconclusive, the data could also be interpreted to indicate three seasons (summer, fall, winter) and four seasons depending on which of the variables received emphasis. Using two seasons allowed for the development of model equations with a corresponding test data set. However, one of the pitfalls of using the two season approach was that during regression analysis of the fall season, a curve fitting the October distribution of darter density would not be expected to fit the January distribution of darter density as they are not statistically the same. Nonetheless, regression analysis was performed to verify this assumption. Development of the presence/absence models would not be affected by this as they are not a function of darter density. In all subsequent analyses, the July data set was employed to develop the summer season equations with the April data set reserved for equation validation. Similarly, October was used for the fall season model generation with January as the validation data set.

Occupancy Model Development

Two models were developed for each of the seasons (summer and fall), one using the continuous transformed variables and one using principle components. In order to develop the second model, principle components were obtained for each

sampling period and added to the data sets. Following the PCA, a stepwise variable selection procedure was used to select which variables would be used in the DFA. The SAS™ default significance level for entry and retention of 0.1000 was used in the selection. The variables selected for each model are shown in Table 7. The value of Wilks' Lambda is a measure of the strength of the relationship or predictive power and is highly correlated to $1-R^2$. Thus, the closer the value of Wilks' Lambda is to zero, the stronger the relationship or better stated the higher the percentage of explained variance. The summer season equations both explained approximately 25% of the variance. The fall season transformed continuous model explained slightly over half of the variance with the principle component model only explaining 30%. The value of Wilks' Lanmba does not translate into the number of correct or incorrect predictions the model will generate, but rather indicates the amount of seperation between groupings.

Table 7. Variables Selected for Discriminate Functions Analysis

MODEL	VARIABLES SELECTED	WILKS' LAMBDA
Summer Transformed Continuous	log bottom velocity	0.7621
Summer Principle components	principle component 1 principle component 2	0.7889
Fall Transformed Continuous	pH arcsin(vegcom1$^{0.5}$) arcsin(vegcom3$^{0.5}$) log average velocity	0.4914
Fall Principle components	principle component 1 principle component 2 principle component 3	0.6923

Once the variables were selected, they were entered into DFA's with the response variable Present which denoted presence or absence of darters. DFA develops two linear combinations of the selected variables with the goal of successfully separating the data set into two groups, present and absent. An example of the resulting equations is shown below for the summer transformed continuous variable model.

$$\text{Absent} = -1.71631 - 2.22288*\log(\text{bottom velocity})$$

$$\text{Present} = -3.41506 - 4.34324*\log(\text{bottom velocity})$$

Whichever of the two equations yields the numerically greater result for a data point is the prediction for that point.

Population Density Equations

In the development of the population density equations, four variations were tried on each sampling period. Regressions using both continuous independent variables and principle components as independent variables were run on both the whole data set and the DFA-modified data set. Recall that the DFA-modified data set consists of all locations that actually contained darters and all of the sites that were predicted to have darters (whether they did or not) according to the presence/absence model previously developed. Sites that had no darters observed and were also predicted to have no darters were removed from this data set. Table 8 summarizes the contents of each model.

Table 8. Model nomenclature and Description

Model Name	Description
Continuous Transformed Whole	Continuous transformed variables used in regression with all observations
Continuous Transformed DFA	Continuous transformed variables used in regression with only sites containing darters and those predicted to have darters by DFA
Principle Components Whole	Principle components used in regression with all observations
Principle Components DFA	Principle components used in regression with only sites containing darters and those predicted to have darters by DFA

As in the DFA, the first step in the regression analysis was to select variables. A stepwise procedure using forward selection and backwards elimination was used with the partial R^2 significance level of 0.1500. The results of the stepwise selection procedure are shown in Table 9. In all cases the dependent variable was the transformed darter density , Log_{10} (darter + 1). The use of the transformed variable was necessary to meet the normality requirements of ordinary least squares regression.

Table 9. Variables Selected for Regression Analysis

MODEL	VARIABLES SELECTED	MODEL R^2
Summer Continuous Transformed Whole	bottom velocity vegetative community 1 vegetative community 3 temperature	0.3091
Summer Continuous Transformed DFA	vegetative community 1 vegetative community 3 temperature	0.1797
Summer Principle Components Whole	principle component 2 principle component 5 principle component 1	0.2441
Summer Priciple Components DFA	principle component 5	0.08
Fall Continuous Transformed Whole	vegetative community 1 vegetative community 3 bottom velocity	0.6154
Fall Continuous Transformed DFA	vegetative community 1 bottom velocity pH dissolved oxygen depth	0.5728
Fall Principle Components Whole	principle component 1 principle component 3 principle component 4	0.3868
Fall Priciple Components DFA	principle component 1 principle component 4	0.2022

As can clearly be seen, the regressions on the whole data sets had significantly higher R^2 values than did those performed on the DFA modified data sets. At this point the hypothesis that the DFA modified population density equations would be more accurate than standard practice was rejected for the Comal River darter. All subsequent analyses involved only the whole data sets.

The next step in the population density equation model development was to perform regressions on the whole data sets with the variables selected above. Although the continuous variables yielded higher predictive power than the principle component regressions, all models were retained pending validation.

Model Testing and Validation

The DFA presence/absence models were the first to be tested. The models developed for each season are shown below.

Summer Season:

Continuous Transformed Variables

(1)

$$\text{absent} = -1.7 - 2.2*\log(\text{average velocity})$$

$$\text{present} = -3.4 - 4.3*\log(\text{average velocity})$$

Principle Components

(2)

$$\text{absent} = -1.2 + 0.4*(\text{prin2}) + 0.3*(\text{prin1})$$

$$\text{present} = -0.6 - 0.2*(\text{prin2}) - 0.2*(\text{prin1})$$

Fall Season:

Continuous Transformed Variables

(3)

$$\text{absent} = -531.2 + 7.3*\log(\text{average velocity}) - 7.6*\arcsin(\text{vegcom3})^{0.5} - 2.8*\arcsin(\text{vegcom1})^{0.5} + 144.9*\text{pH}$$

$$\text{present} = -518.8 + 7.4*\log(\text{average velocity}) - 5.5*\arcsin(\text{vegcom3})^{0.5} + 0.001*\arcsin(\text{vegcom1})^{0.5} + 143.0*\text{pH}$$

Principle Components

$$\text{absent} = -0.86 + 0.2^*(\text{prin1}) + 0.5^*(\text{prin2}) + 0.3^*(\text{prin3})$$
$$\text{present} = -0.96 - 0.2^*(\text{prin1}) - 0.5^*(\text{prin2}) - 0.3^*(\text{prin3}) \quad (4)$$

The presence/absence models from the DFA's were tested using a contingency table approach with the Chi-square statistic. Each model developed previously was used to generate a prediction for each grid cell for both the model data set and the corresponding test data set. The prediction was then compared to the field data for that cell. Numbers of Type I errors, Type II errors, and correct responses were tabulated for each model and placed in a contingency table as shown in Table 10. The predicted value for a particular sampling period was obtained by multiplying the total number of observations for a sampling period by the ratio of the total responses for the season to the number of total observations. For example, in Table 10 the expected number of Type I errors for July was 117*39/189 = 24.14.

The value of $X^2 = \Sigma\Sigma$(observed - predicted)/predicted. The critical value of X^2 or a 3 x 2 contingency table is obtained by first calculating v which equals (3-1)(2-1) =2 and then looking it up in a Table of critical values. The critical value for $X^2_{2,.05} = 5.991$. The values of X^2 for each model are shown in Table 11.

Table 10. Contingency Table for Chi-Square Testing of the Occupancy Models

	PREDICTION RESULTS						
Model	TYPE I		TYPE II		CORRECT		TOTAL
Summer Continuous Transformed	observed	predicted	observed	predicted	observed	predicted	
July	19	24.14	7	7.43	91	85.43	117
April	20	14.86	5	4.57	47	52.57	72
Total	39		12		138		189
Summer Principle Components	observed	predicted	observed	predicted	observed	predicted	
July	21	24.76	5	6.81	91	85.43	117
April	19	15.24	6	4.19	47	52.57	72
Total	40		11		138		189
Fall Continuous Transformed	observed	predicted	observed	predicted	observed	predicted	
October	15	14.20	9	16.38	65	58.42	89
January	11	11.80	21	13.62	42	48.58	74
Total	26		30		107		163
Fall Principle Components	observed	predicted	observed	predicted	observed	predicted	
October	23	21.84	6	11.47	50	50.23	89
January	17	18.16	15	9.53	42	41.77	74
Total	26		30		92		163

Table 11. X^2 Values for Contingency Table Testing of DFA Presence/Absence Models where H_0 : The Model Performs the same between sampling periods.

	Critical Value for $X^2_{2,.05} = 5.991$	
MODEL	X^2	**TEST RESULT**
Summer Continuous Transformed	3.8944	Do Not Reject H_0
Summer Principle Components	3.7163	Do Not Reject H_0
Fall Continuous Transformed	9.0556	Reject H_0
Fall Principle Components	5.878	Do Not Reject H_0

Both the continuous transformed variable model and the principle component model for predicting darter presence/absence (equation sets 1 and 2) developed for the summer season on the July data set were acceptable for use in predicting habitat suitability for the April data set. For the fall season, only the model developed from principle components (equation set 4) from October is marginally acceptable for predicting habitat suitability in January.

Testing the regression equations developed for summer and fall with the April and January data sets respectively was the next step in the analysis. The density equations were developed by regressing the variables selected in the stepwise procedure on the log of darter density and are shown below.

Summer Season

Continuous Variables

$$(5)\ \log_{10}(\text{darter} + 1) = 2.8 - 0.25*(\text{bottom velocity}) + 0.008*(\text{vegcom1}) + 0.004*(\text{vegcom3}) - 0.10*(\text{temperature})$$

Principle Components

$$(6)\ \log_{10}(\text{darter} + 1) = 0.5 - 0.12*(\text{prin comp 3}) - 0.09*(\text{prin comp 1}) - 0.1*(\text{prin comp 5})$$

Fall Season

Continuous Variables

$$(7)\ \log_{10}(\text{darter} + 1) = 0.14 - 0.28*(\text{bottom velocity}) + 0.008(\text{v1egcom1}) + 0.004*(\text{vegcom3})$$

Principle Components

$$(8)\ \log_{10}(\text{darter} + 1) = 0.28 - 0.07*(\text{prin comp 1}) - 0.07*(\text{prin comp 3}) + 0.09*(\text{prin comp 4}) - 0.09*(\text{prin comp 2})$$

The April and July data sets were then run through the two equations generated for summer (equations 5 and 6) to generate a predicted darter density. The same procedure was accomplished for October and January with the Fall equations (7 and 8). The predictions were then regressed against observed darter densities for each sampling period using a 'no-intercept' regression model. The 'no-intercept' model was specified since the intercept was already built into the prediction. Running this regression on July and October standardized the degrees of freedom with the test sampling periods so that predictive power could be compared directly. The results of

the regressions are shown in Table 12.

Table 12. Regression Analysis Results of Predicted vs Observed Darter Densities, DF=1

	R^2			
	Generation Period	Test Period	Generation Period	Test Period
Model	July	April	October	January
Continuous Variables	0.66	0.68	0.74	0.41
Principle Components	0.55	0.46	0.63	0.36

For both seasons, the continuous variable regression model yielded higher predictive power than did the corresponding principle component equation. The summer season equations appear consistent between the two sampling periods for the amount of variation explained by the model. The fall season equation, however, does not explain nearly as much of January's variation as it does for October. This is expected as the population densities are statistically different in October and January and one equation can not be expected to fit both equally well.

The final step in the determination of model validity across seasons was to conduct ANCOVA's on the combined data sets. A summer data set was built by combining the July and April data sets. Similarly, a fall data set was constructed from October and January. The ANCOVA's were run on the observed darter density versus the categorical variable 'Period', the predicted darter density, and the interaction between 'Period' and the prediction. Table 13 shows the results of the F-tests concerning each variables significance. For a model to successfully fit both sampling

periods in a season, the 'Predict' term should be significant as it indicates the regression line while the 'Period' and interaction terms should not be significant as they indicate intercept and slope modifiers respectively.

Table 13. Analysis of Covariance Results

	Variables	Summer Continuous Variables	Summer Principle Components	Fall Continuous Variables	Fall Principle Components
Pr>F	Period	0.417	0.0041	0.0006	0.0003
	Predict	0.0001	0.3557	0.0001	0.0019
	Period*predict	0.2066	0.005	0.0022	0.0096

The only model which passes α=0.05 under these constraints is the summer model with continuous variables (equation 5). All other models indicate two regression lines for the two sampling periods rather than one.

Testing for multicollinearity and normality of residuals were the final steps of the model validation process. Multicollinearity exists when there are strong relationships among the x-variables in that one or more of them may be expressed as a linear combination of the others. Multicollinearity was tested for using the collinearity diagnostics contained within SAS™. SAS™ produces eigenvalues and condition indices that indicate whether multicollinearity may exist. To determine if multicollinearity exists, the condition indices (scale independent) were examined for large jumps between values. Scale independence is important as it allows for the direct comparison of variables that may have been collected in completely dissimilar measurement units. Evidence of multicollinearity exists between the vegetative

communitites and with temperature. Accomplishing the regression on the transformed x variables reduced the degree of multicollinearity but did not eliminate it. Removing temperature from the regression reduced the value of R^2 from 0.3156 to a value of 0.2807 and removed any traces of multicollinearity. The condition indices for each case are shown in Table 14.

Table 14. Multicollinearily Diagnostics: Condition Indicies

	Condition Index		
Variable	Continuous X's	Transformed X's	Deleted Temperature
Intercept	1	1	1
bottom velocity	1.75	2.12	1.45
vegetative community 1	1.86	3.26	1.55
vegetative community 3	3.57	4.91	3.43
temperature	69.84	25.62	

Normality of the residuals from the regression was tested both by univariate statistical procedures previously discussed and graphically through a plot of residuals versus predicted darter density. The univariate procedure calculated a value of W = 0.985. The normal probability plot (Figure 5) was nearly perfect. The plot of residuals versus predicted darter density (Figure 6) demonstrated normality of residuals in that there existed a fairly even distribution above and below the zero axis. However, it also demonstrated mild heteroscedasticity; the value of the residuals increased with the value of the prediction. This observation was tested by regressing the predicted values of darter density on the absolute value of the regression residuals.

The regression indicated a positive slope of 0.027. The regression line is also shown in Figure 6. The degree of heteroscedasticity can be termed mild as the slope of this line is fairly flat and the model R^2 of 0.06 indicates a weak relationship between the magnitude of the prediction and the magnitude of the corresponding residual. Since the original regression was performed on transformed data, no options are available to eliminate this problem. While ordinary least squares regression is considered a fairly robust method, heteroscedasticity violates the assumption that errors have constant variance (Hamiltion 1992).

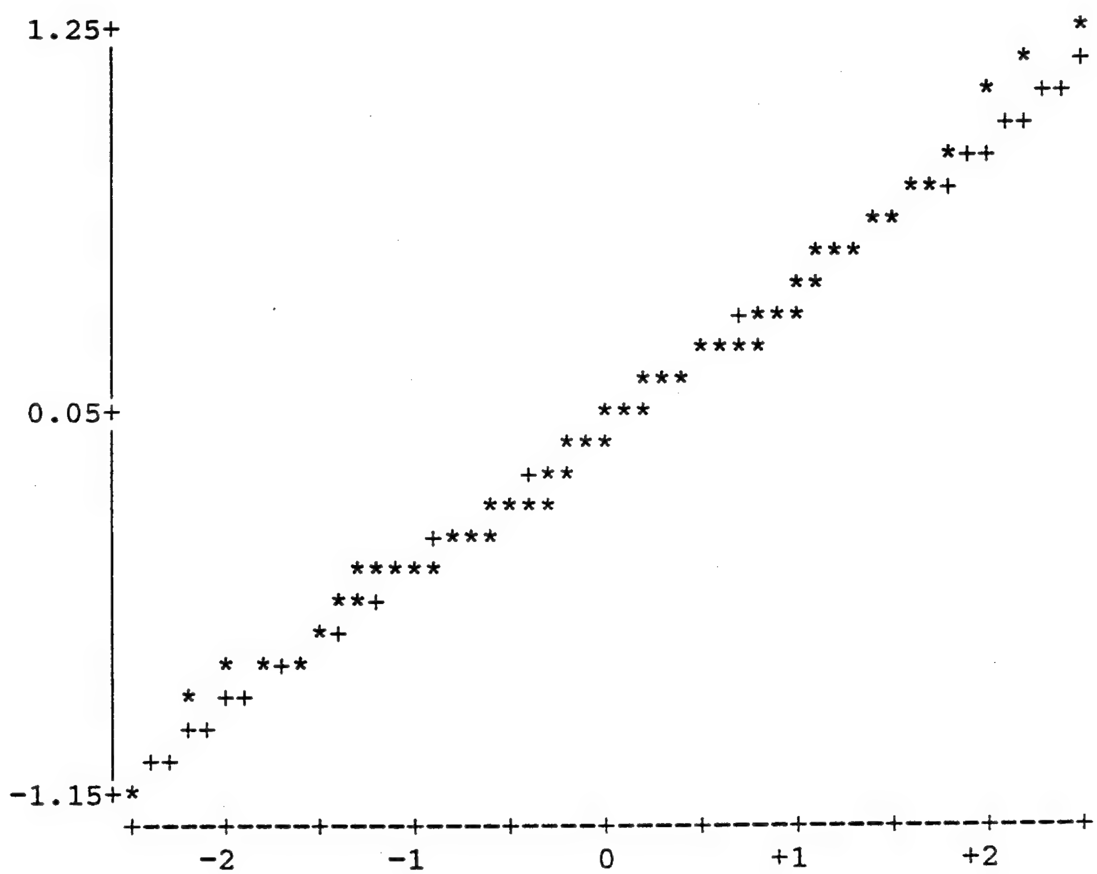

Figure 4. Normal Probability Plot of the Regression Residuals

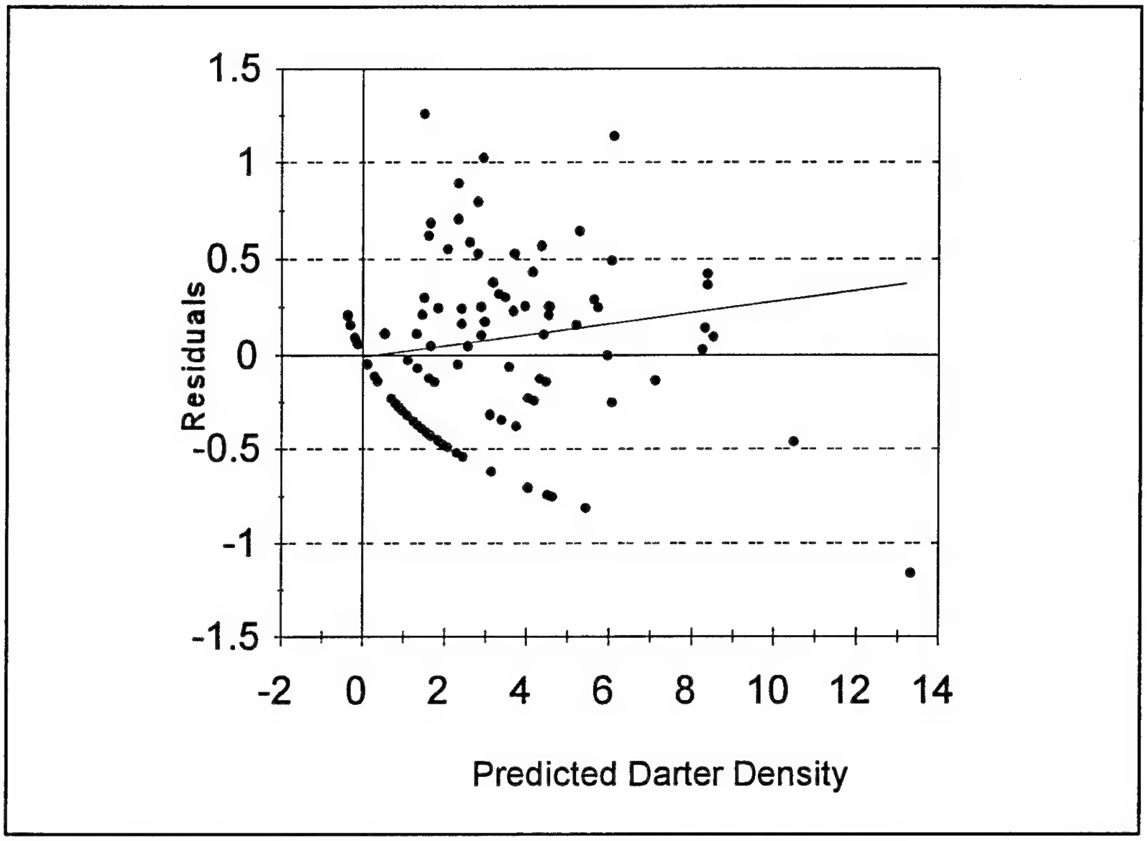

Figure 5. Plot of Regression Residuals vs Predicted Darter Density

The final version of the darter density equation for the summer season is shown below:

(9) $\log_{10}$ (darter + 1) = 0.43 - 0.3*(bottom velocity) + 0.007*(veg com 1) + 0.003*(veg com 3)

The predictive power of the summer season darter density equation (R^2 = 0.28)

indicates that this analysis failed to explain a large portion of the variation in darter densities. Similarly, the presence/absence models have fairly low (high) values of the Wilk's Lamba statistic. This indicates that the methodology employed in this study failed to account for some significant criteria for habitat selection or that factors critical to understanding habitat selection were not included in the factors analyzed. This study focused on the analysis of physical habitat variables encountered by darters living in the Comal River but did not evaluate all available data such as invertebrates, co-occurring fish species or adjacent cell vegetative characteristics. Other factors that may be equally or more important in habitat selection include predation, food supply, and competition.

One aspect of data analysis that was not addressed in this study was analysis of the spatial component. The number of data points gathered necessitated grouping the data by season rather than by location. Each cell's habitat was treated equally without regard to the habitat in adjacent cells or to that cell's location in the overall river system. In addition, this preliminary analysis did not consider stratification of the Comal River System into reaches in order to ensure adequate sample size. It is anticipated that exclusion of the strata within the new channel may improve model development.

CONCLUSIONS

1. All of the project goals were met with varying degrees of success. The statistical methodology outlined in Figure 4 provided a flexible framework to evaluate

the data set. The SAS™ programs written to accomplish this methodology are included in Appendix 3 and on the 3.5" diskette.

2. Three presence/absence models were successfully developed for use in determining habitat suitability for the fountain darter. Equations 1 and 2 apply to the summer season while equation 3 applies to the fall season. The equations for the summer season achieve approximately 84% accuracy while the fall season equation only achieves approximately 55% correct responses.

3. The two-step hierarchical approach to generating a population density predictive equation yielded significantly lower predictive power than the traditional approach of developing density equations for the whole data set. Only one population density equation was found to be statistically valid across sampling periods. Equation 9 can be used to predict darter densities during the summer season with a predictive power of approximately 28%. However, this equation suffers from heteroscedasticity and therefore violates one of the assumptions concerning linear regression.

4. The essential physical variables required in this analysis were velocity (both bottom and average) and vegetative community. They occur in every predictive model either directly or as substantial portions of the derived principle component.

RECOMMENDATIONS

1. The invertebrate data that has recently been provided should be incorporated into the data files that are the basis for this study and the analysis reaccomplished.

2. A spatial component needs to be added to the analysis to account for

variation associated with distance downstream, as well as spatial effects associated with adjacent cell attributes.

3. The system should also be analyzed for stratification among the reaches. For example, the spring runs, new channel, and old channel are most likely statistically different rivers rather than one. This study excluded the spring run data as the difference was realized, but the new channel and old were not differentiated.

4. The age or size distribution of the darters needs to be accounted for in the next analysis. In this study each darter was treated as a unit fish which may not account for seasonal variation in darter concentrations due to reproduction.

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APPENDIX 1

Habitat and Flow Requirements Study for the Comal Ecosystem

Study Plan

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for

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INTRODUCTION

As part of recovery implementation for listed San Marcos/Comal species and their ecosystems, as well as the conservation of candidate species, the U.S. Fish and Wildlife Service (Service) desires to assess the instream flow needs of the flow dependent aquatic resources (i.e., species and communities) of the Comal ecosystem. Although this effort will target the fountain darter (Etheostoma fonticola) and Comal Springs riffle beetle (Heterelmis comalensis), the other aquatic resources of the ecosystem are recognized as an integral part of the overall system upon which these particular species are interdependent. The Service proposes to bring together an interdisciplinary team of scientists and resource management specialists to conduct necessary studies in order to develop data and analyses that can be used to formulate instream flow strategies for the protection of the Comal ecosystem. The Service recognizes that existing and on-going research efforts within the Comal Springs ecosystem are providing valuable information to meet the study goals, and this study design is intended to complement and, where possible, integrate these efforts.

Study Objectives

To accomplish the overall study goal of developing instream flow strategies that will protect the Comal Springs ecosystem, the Service has identified the following specific study objectives:

Objective 1: Quantify existing physical and biological characteristics of the Comal Springs ecosystem.

Objective 2: Assess the flow dependent relationships between physical habitat and life history requirements of the aquatic species within the Comal Springs ecosystem.

Objective 3: Develop instream flow recommendations that protect the Comal Springs ecosystem particularly native species.

To accomplish these broad objectives, several specific tasks have been identified and are discussed below.

1.0 Quantification of the Existing Physical Environment.

Task 1.1 Quantify existing and historical flow regimes.

This task will involve the compilation and analysis of data on discharge rates from the Comal Springs system. This data set will be used later in the study for physical habitat modeling. Data available from the U.S. Geological Survey and others will be used to characterize discharge from all identifiable springs and water courses flowing into the Comal Springs system (Blieders Creek, Panther Canyon, and Comal Creek). Flow data will be evaluated for temporal patterns/trends (e.g., seasonal) and variation. The objective is to develop the hydrology data set to use as input for hydraulic and habitat modeling.

Task 1.2 Map existing aquatic and riparian habitats within the Comal Springs ecosystem.

A key data need for this study, as well as for long term monitoring activities, is an accurate aquatic and riparian habitat map for the entire Comal Springs ecosystem from the head water spring runs, downstream to the confluence with the Guadalupe River. Some morphometric and water course mapping data are already available and additional sources of information are being pursued. It is anticipated that airborne multi-spectral videography will be used to acquire ground coverage with a spatial resolution of no greater than 0.5 meters. This coverage may be supplemented by low level aerial photography. The imagery will be digitized and, in conjunction with ground truth data, serve as the basis to develop a GIS based (ARC/INFO™) habitat map for the Comal Springs system. The mapping will involve the delineation of aquatic macrohabitats important to fish and other aquatic species such as runs, pools and riffles, as well as the distribution and density of aquatic and riparian vegetation. Additional map features will include the location of spring inflows, dam structures, surface water courses, water diversion structures, etc, and may be expanded based on the analysis needs of the IDT.

The mapping effort will also serve as the basis for the delineation of large scale homogeneous reaches throughout the Comal Springs ecosystem and for the development of a standardized spatial sampling protocol for the further biological characterization of the system (described below).

Task 1.3 Delineate large scale homogeneous reaches and standardized spatial sampling grid.

The sampling design to be employed is stratified random sampling. All potential sampling sites in the Comal ecosystem will be divided into homogeneous reaches (referred to below simply as reach or reaches) based on similar physical characteristics. In other words, a reach generally has homogeneity of morphometry and flow. However, each reach has spatial heterogeneity on a smaller scale in the form of different macrohabitats.

The reaches will serve as the basis for a stratified random sampling design to further characterize the biological components of the system. These reaches become the strata of the sampling design.

Based on the detailed mapping effort under Task 1.2, the entire Comal Springs system will be partitioned into reaches based on the physical characteristics. This process will be conducted by the IDT based on a review of the mapping results and site visit. The mapping effort in Task 1.2 will also provide a grid delineating macrohabitats (e.g., runs, pools, riffles, etc.) and aquatic vegetation. Multiple sites will be selected and sampled within each reach to describe the reach as a whole (Task 1.4).

Previous research by Texas Parks and Wildlife Department delineated three portions of the Comal ecosystem for their study on fountain darters, namely, Landa Lake, Comal River's old (original, natural) channel, and Comal River's new (modified) channel.

Several distinct reaches have been tentatively identified based on an initial survey and review of available data for the Comal ecosystem. Tentative reaches include the upper, middle, and lower sections of Landa Lake, spring runs (associated with springs labeled by Gunnar Brune (1981, Springs of Texas, page 131) as j, k, and l), and distinct sections of the old and new channels.

Task 1.4 Characterize the macrohabitat properties of homogeneous reaches.

Once the Comal Springs system has been partitioned into discrete reaches, each reach will be examined to locate a smaller scale representative section (e.g., 100 meter longitudinal section) in which to take intensive physical measurements. Unlike the sampling design for the biological data which involved random cells within a reach, representative sections will be selected within a reach based on the distribution of macrohabitats and best professional judgment of the IDT. These smaller scale representative sections (referred to below as section(s)) will be used as prototypes of the larger scale reaches for the hydraulic modeling as described below. The sections

will be selected by the IDT based on both the mapping results and site visits. For each section, cross-section profiles of depth, velocity, substrate, vegetation type and coverage, water surface elevation and discharge will be measured at 20 to 30 locations across each macrohabitat. A sufficient number of cross-sections will be placed within each section to ensure an adequate characterization of the macrohabitat features present. Each section will be permanently marked and referenced to the map base produced in Task 1.2. If indicated, sections will correspond to (or encompass) existing transect sites used by the Texas Park and Wildlife Department.

The specific number and location of cross-sections will be determined by the IDT after a review of the mapping results and site visits. Measurements at each cross-section will be taken at a minimum of three discharge levels and if possible, given time, manpower and flow constraints, as many additional data sets will be taken as practical.

Flow levels targeted for measurement are at approximately each 50 percent reduction in flow over discharge ranges between 500 and 0 cubic feet/second as measured at the USGS's gage near the San Antonio Street Bridge.

Task 1.5 Develop and test hydraulic models appropriate for use in simulating characteristics of macrohabitats within each homogeneous reaches.

This task will focus on the development and testing of suitable hydraulic models to represent each of the study sites where intensive data have been collected under Task 1.4. The hydraulic models will be used to estimate macrohabitat hydraulic properties such as water surface elevations, depth, and velocities over ranges of discharges not measured during the field investigations. Selection and application of models will be determined after the initial field data collections conducted under Task 1.4 and reviewed by members of the IDT. It is anticipated that Landa Lake and areas significantly influenced by back water effects from dams will be modeled using fast flushing (small) reservoir models, while the more typical flowing stream habitats will be modeled using hydraulic simulations routines developed by the Service's Instream

Flow Group.

<u>Task 1.6</u> **<u>Evaluate and use aquifer models to generate synthetic flow regime dataset</u>**

A number of relations and models have been developed that relate aquifer levels to discharge rates of the Comal Springs system. The Interdisciplinary Team (IDT) will review these models and select the most suitable model(s) to generate summary results that relate seasonal aquifer levels to seasonal spring discharge rates. The specific content and format of the model output will be identified based on the needs of modeling efforts by IDT members.

2.0 Quantification of the Existing Biological Environment.

<u>Task 2.1</u> **<u>Document historical abundance of key/target aquatic and riparian system species.</u>**

Considerable effort has been invested by several entities to delineate the distribution and abundance of aquatic and riparian species within the Comal Springs ecosystem. Recent work is now available which will add significantly to the understanding of the ecosystem. This task will focus on obtaining and summarizing available information for use in the existing study, especially for those efforts that have quantitative data on both species abundance, distribution, and macrohabitat use.

<u>Task 2.2</u> **<u>Determine existing distribution of aquatic species within specific macrohabitats in each large scale homogeneous reach.</u>**

For each of the reaches, the surface area will be partitioned into 10 m^2 (3.16 m by 3.16 m) grid to produce a series of unique cells that define the available macrohabitats throughout each reach (stratum). Texas Parks and Wildlife Department's work on the Comal involved sampling 10 m^2 cells and the intent is to use a similar size cell. Within each reach, a minimum of 10 percent of the cells will then be randomly selected for use in the biological sampling efforts described below. Randomly

selected cells will then be further divided into 0.5 m^2 (70.7 cm by 70.7 cm) sub-cells for use in the macroinvertebrate sampling efforts as described below. The grid system(s) and data developed for each reach will be added to the GIS map system. Biological sampling will be conducted within a one week period of the hydraulic sampling efforts, or in the event that flows do not change more than 50 percent over a three month period, the biological sampling will be initiated.

<u>Landa Lake/Impoundment Aquatic Macroinvertebrates:</u> All selected sub-cells within each reach of Landa Lake and other non-flowing reaches within the Comal Springs system will be sampled for snail population densities by randomly selecting three 0.5 m^2 areas within each 10 m^2 cell to estimate snail densities using the existing methodology employed by Dr. Tom Arsuffi. This technique uses a plexiglass viewing plate of 0.5 m^2 dimensions held at the water surface. The vegetation is illuminated using hand held diving lights and the numbers and, where feasible, the species of snails will be enumerated within each of the selected three sampling locations. Snail sampling will be accomplished during the evening period when snails migrate to the top of the vegetation. At each of the sampled cells, the depth, velocity, substrate, and vegetation type, including percent aerial coverage and height above the bottom will be noted at the time of sampling. Water temperature, turbidity (or transparency), conductivity, dissolved oxygen, and pH will also be measured in each sampled cell during the field collections. In addition to the snail density estimates within each sub-cell, other aquatic macroinvertebrate densities will be estimated using a suitable sampling protocol. At present, the specific sampling protocol has not been determined by the IDT and will be decided after review of previous sampling success identified under Task 2.1. This sampling effort would be conducted immediately after completion of the three replicate snail density estimates within each cell, within the same three replicate sub-cell sites.

<u>Riverine Aquatic Macroinvertebrates:</u> Sampling of riverine reaches will also involve the random selection of a minimum of 10 percent of the available area within each reach. For each of the selected cells, 3 replicate samples will be taken from randomly

selected sub-cells within the 10 m^2 cell. Sampling within the spring runs will follow the existing techniques of Dr. Cheryl Barr for the Comal Springs riffle beetle. Sampling for aquatic macroinvertebrates in other riverine areas will employ kick net samples or other sampling gear identified by the IDT after a review of previous sampling efforts identified under Task 2.1. At each of the sampled cells, the depth, velocity, substrate, and vegetation type, including percent aerial coverage and height above the bottom will be noted at the time of sampling. Water temperature, turbidity, transparency, conductivity, dissolved oxygen, and pH will also be measured in each sampled cell during the field collections.

Fisheries: Fish distribution and abundance using a combination of netting, electrofishing, trapping, and visual gear will be conducted within each randomly selected 10 m^2 cell within each reach. Sampling for fishes will be conducted between 24 and 48 hours after the aquatic macroinvertebrate sampling. The specific sampling strategy for a selected cell will be determined at the time of sampling based on the depth, vegetation cover, and other physical factors that may severely bias the sampling effort. The total number of each species of fish observed or captured in each cell will be noted, including either visual estimates of the standard length (mm) measured for captured individuals. If age class (i.e., Ø class, I class) is apparent, that will be noted. At each of the sampled cells, the depth, velocity, substrate, and vegetation type, including percent aerial coverage and height above the bottom will be noted at the time of sampling. Water temperature, turbidity (or transparency), conductivity, dissolved oxygen, and pH will also be measured in each sampled cell during the field collections.

Zooplankton of Comal Springs Ecosystem

Zooplankton abundance and distributions will be evaluated using a conventional methods.

Task 2.3 **Summarize life history requirements of the aquatic system species, especially those most likely to be flow dependent at the microhabitat scale.**

Many of the native and non-native species have been studied extensively (e.g., smallmouth bass) while others have received little or no extensive life history work. The existing literature and unpublished data on the life history requirements of the identified aquatic species will be solicited from management agencies and researchers active in the Comal Springs system, San Marcos River system, and other systems containing the more ubiquitous species such as the non-native fishes. This information will be supplemented by the collection efforts outlined in Task 2.2. Compilation of this material will aid the IDT to select target species for inclusion in the instream flow analyses based on the extent and applicability of available literature/data in conjunction with the information collected during the biological sampling efforts. The selection of target species for inclusion in the instream flow assessments will be given to both native and non-native species of fish, invertebrates, and vegetation with a goal of representing the diversity of species habitat requirements or community level assemblages. Final selection of target species may to a large degree be determined by lack of suitable data or knowledge of life history requirements.

Task 2.4 **Develop habitat suitability functions for target native and non-native aquatic species for use in habitat modeling.**

This task will involve a synthesis of the life history information collected on both the native and non-native species, the sampling data obtained from the biological sampling efforts, and professional judgement of knowledgeable researchers to develop habitat suitability functions. These functions will serve as the basis for modeling habitat requirements over the range of discharges to be examined in this study. The form of the suitability criteria will be determined based on the availability of existing data and that data collected during the biological field sampling efforts. It is likely that many of the target species will not have sufficient quantitative data or known life history requirements and therefore a guilding approach may be required. If guilding is undertaken, then representative species from each of the spatial niches (i.e.,

macrohabitats) will be selected with the best quantitative data and collective knowledge of species experts to represent species for which habitat suitability data are not available. Based on the initial review of available information on species life history requirements and data analyses from the biological sampling program, laboratory studies may be initiated by the IDT for selected species to obtain necessary data judged to be critical to the successful determination of flow dependent relationships used in the instream flow assessment process.

This task will bring together all available data on the life history and habitat associations of fountain darters with the intent of formulating an accurate and unbiased suitability criteria.

3.0 Analyze Flow Dependent Relationships of Target Native and Non-native Aquatic and Riparian System Species.

Task 3.1 Develop flow dependent relationships for target native and non-native species for each homogeneous reach within the system.

The habitat suitability functions for the native and non-native target species developed under Task 2.4 will be used in conjunction with the hydrology and hydraulic model outputs developed under Tasks 1.1 and 1.4 to produce flow dependent relationships for available habitat conditions throughout the Comal Springs system for the range of simulated discharges. In addition, other modeling approaches will be considered, such as spatial niche diversity as a function of discharge, Habitat Suitability Index Models (HSI), Habitat Evaluation Procedures (HEP), Index of Biotic Integrity (IBI), etc, based on on-going data analysis and discussions of the IDT. Spatial niche diversity analyses, for example, would focus on a determination of the relationship between the number and characteristics of specific macrohabitat types within each reach as a function of flow magnitude and flow magnitudes that maximize the diversity of these features would be considered in light of the habitat requirements of the target native and non-native species. Modeling approaches will be discussed, examined and applied where such techniques improve the understanding of the interaction between

flow and life history requirements of the native and non-native target species within the Comal Springs ecosystem. Although physical habitat modeling will be the primary focus of this effort, water quality modeling may be initiated based on the general consensus of the IDT, that water quality may become limiting within Landa Lake during very low discharge periods. The decision to undertake water quality modeling will be made based on a review of the available data, data collected during the biological sampling efforts, time, and budgetary constraints.

Task 3.2 Formulate instream flow recommendations that optimize for native species and minimize conditions for non-native species.

The results of the various modeling efforts, literature reviews, data analyses, and professional judgment of knowledgeable species experts will then be integrated by the IDT to develop instream flow recommendations that optimize the protection of native species within the Comal Springs system while minimizing, where possible, favorable conditions for non-native species. It is recognized that some non-native species may be eurytopic, having a wide range of tolerance to a number of environmental factors, including, but not limited to flow. However, some non-natives (e.g., the herbivorous giant (Columbian) rams-horn snail, Marisa cornuarietis) may be at a disadvantage during certain flow regimes (i.e, under suboptimal or unsuitable conditions). It is fitting and important to know what minimizes suitable conditions for non-natives and take that in to consideration when developing recommendations for to optimize habitats for native species.

It is anticipated that a range of flows will be considered, possibly on a seasonal basis, where flow magnitudes may result in anticipated unacceptable adverse impacts to native, particularly listed, species.

Time required table by task

(Exclusive of Dr. Thomas B. Hardy's time).

Technician refers to any competent individual with the background to help in subject area IDT refers to collective study team (independent review or as a team meeting by context) Other disciplines by titles

Task 1.1	Hydrologist	1 week review [USGS DATA] time per model 1 week processing time and summarization of information
	Technician	4 week support for hydrologist
	IDT	2 days review of model choice and model output review
Task 1.2	Technician	~~1~~ weeks x ~~2~~ 4 people ground truth mapping - vegetation and fisheries background 1 week existing data compilation
Task 1.3	Technician	1 week grid delineation and GIS update.
	IDT	3 days review of reach delineations and collective site visit if necessary
Task 1.4	Technician	1 week x 8 people per flow level help with cross section surveys
	IDT	1 week select representative sections in each reach and cross section location
Task 1.5	IDT	3 days review of hydraulic model selection by reach
Task 1.6	Hydrologist	
Task 2.1	Technician	2 weeks data summary of requested information
	IDT	3 days review of existing information
Task 2.2	Technician	1 week grid development and random cell generation 1 week x 12 people each flow or 3 month period invert and fish collection 1 month for aquatic invert sample processing if undertaken for each sample period

		2 weeks data reduction and analysis
	Fisheries	1 week data analysis per sampling effort
	Invertebrate Ecology	1 week data analysis per sampling effort
	Aquatic Vegetation	1 week data analysis per sampling effort
	IDT	3 day summary review each trip
Task 2.3	Technician	3 weeks data request and data summary
	IDT	1 week for each taxa and/or species expert
	IDT	2 days target species selection
Task 2.4	Technician	1 week data analysis and support
	IDT	2 weeks data review, discussion, etc.
Task 3.1	Technician	2 months analysis support
	IDT	1 month data/analysis review
Task 3.2	Technician	1 month report generation support
	IDT	1 month analysis review, integration, discussion, report writing

Timing of Task Start and Completion

	Start	End
Task 1.1	Immediately	End of 1st month of project
Task 1.2	Late September 1992	October 31, 1992
Task 1.3	October 15, 1992	October 31, 1992
Task 1.4	November 1, 1992	3 months before report due
Task 1.5	Immediately	January 1993
Task 2.1	Immediately	January 1993
Task 2.2	November 1, 1992	3 months before report due
Task 2.3	Immediately	April 1993
Task 2.4	December 1992	3 months before report due
Task 3.1	April 1993	3 months before report due
Task 3.2	June 1993	1 month before report due
Draft Report		August 31, 1993
Report Review and Revisions		
Final Report		October 29, 1993

APPENDIX 2

This appendix includes information on the structure of the data files used in accomplishing the Comal River project, codes for interpreting categorical data, and the SAS printout of the combined data set.

File Structure

Quattro Pro Files

Comal.wb1-contains the raw physical habitat data for July and October

Comal2.wb1-contains the raw physical habitat data for January and April

Fish1a.wb1-contains the fish sampling data for July

Fish1b.wb1-contains the fish sampling data for October

Fish2a.wb1-contains the fish sampling data for January

Fish2b.wb1-contains the fish sampling data for April

Sample1f.wb1-combines the physical and fish data for July, calculates average velocities

Sample2f.wb1-same as above but for October

Sample3f.wb1-same as above but for January

Sample4f.wb1-same as above but for April

April.txt-ASCI text files of selected fields from Sample4.wb1-allows export to SAS

Jan.txt-ASCI text files of selected fields from Sample3.wb1-allows export to SAS

July.txt-ASCI text files of selected fields from Sample1.wb1-allows export to SAS

Oct.txt-ASCI text files of selected fields from Sample2.wb1-allows export to SAS

SAS files

April.dat-SAS conversion of April.txt downloaded from Quattro Pro. Data files also exist for the other three text files; same name, new extension.

A printout of the combined data set, all sampling periods, is included in this Appendix. The variables used are explained below:

Obs-SAS observation number starting with n=1.

Strata-The strata the sample was taken from.

Grid - The grid number within the strata of the cell sampled.

Perveg- percent vegetative cover

Domveg - Dominant vegetative cover species - see USF&WS attachment for codes

Subveg - Subdominant vegetative cover species

Perdv - percent dominant vegetative species = .75*perveg if subveg exists, else =perveg

Persv - percent subdominant vegetation = .25*perveg

Temp - water temperature

DO - dissolved oxygen content

pH - pH of the sample

SC - specific conductivity

Depth - depth of the sample cell

VBOT - velocity 15 cm from the cell bottom

VAVG - mean column velocity

NUMSPEC - number of fish species caught

NUMPASS - number of sampling passes for fish

Darter - number of darters caught

Period - indicates month sample taken: 1 = July, 2=October, 3=Jan, 4=April

DVEGCLS - dominant vegetative cover class (1-3)

SVEGCLS - subdominant vegetative class (1-3)

DCOM1- percent of dominant vegetation that is type 1 in a grid cell

DCOM2 & DCOM3 - same as DCOM1 except for types 2 & 3 veg classes

SCOM1 - SCOM3 - same as DCOMs except for subdominant vegetation

VEGCOM1-Overall vegetative community type 1 for a cell = DCOM1 + SCOM1

VEGCOM2 & VEGCOM3- same as vegcom1 except for types 2 & 3

Note: Sum of 3 VEGCOM variables equals the percent vegetative cover for a cell.

The codes used by the USF&WS for substrates, plants, habitat types, fish, and invertebrates is also included in this Appendix.

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT
1	1	117	90	2	6	67.5	22.5	26.93	7.16	7.33	538	2.50	0.03
2	1	125	100	2	6	75.0	25.0	27.81	8.63	7.41	530	2.40	0.04
3	1	133	20	2	0	15.0	5.0	25.26	5.68	7.23	547	2.70	0.03
4	1	140	50	2	8	37.5	12.5	25.24	6.57	7.26	551	2.90	0.01
5	1	148	100	8	2	75.0	25.0	.	.	.	.	2.90	0.01
6	1	156	50	1	0	50.0	0.0	24.87	5.30	7.22	549	3.20	0.04
7	1	170	90	1	8	67.5	22.5	24.45	4.65	7.20	549	4.20	0.02
8	1	57	60	2	6	45.0	15.0	26.95	7.96	7.28	541	3.35	0.03
9	1	83	100	2	0	75.0	25.0	27.31	7.58	7.29	543	2.00	0.05
10	10	19E	0	0	0	0.0	0.0	26.06	7.42	7.50	729	2.40	0.05
11	10	20E	0	0	0	0.0	0.0	26.01	7.09	7.49	737	3.00	0.08
12	10	290E	0	0	0	0.0	0.0	24.38	7.21	7.45	545	2.50	0.60
13	10	352	0	0	0	0.0	0.0	24.74	7.18	7.42	545	4.50	0.38
14	10	370	0	0	0	0.0	0.0	24.72	7.16	7.42	546	4.60	0.22
15	10	408E	0	0	0	0.0	0.0	24.65	7.19	7.45	545	4.00	0.27
16	10	480E	0	0	0	0.0	0.0	24.65	7.15	7.46	545	4.00	0.53
17	10	507E	100	8	0	75.0	25.0	24.63	7.15	7.41	545	3.00	0.01
18	11	320E	0	0	0	0.0	0.0	23.77	6.91	7.52	543	3.00	0.03

OBS	VAVG	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
1	0.030	8	15	2	1	3	3	0	0	67.5	0.0	0	22.5	0.0	0	90.0
2	0.050	8	15	0	1	3	3	0	0	75.0	0.0	0	25.0	0.0	0	100.0
3	0.020	4	15	0	1	3	.	0	0	15.0	0.0	0	0.0	0.0	0	15.0
4	0.030	9	14	1	1	3	1	0	0	37.5	12.5	0	0.0	12.5	0	37.5
5	0.070	5	15	3	1	1	3	75	0	0.0	0.0	0	25.0	75.0	0	25.0
6	0.005	8	16	23	1	3	.	0	0	50.0	0.0	0	0.0	0.0	0	50.0
7	0.010	3	15	0	1	3	1	0	0	67.5	22.5	0	0.0	22.5	0	67.5
8	0.050	8	15	0	1	3	3	0	0	45.0	0.0	0	15.0	0.0	0	60.0
9	0.040	9	15	3	1	3	.	0	0	75.0	0.0	0	0.0	0.0	0	75.0
10	0.045	2	15	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
11	0.010	0	15	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
12	0.795	0	15	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
13	0.485	0	10	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
14	0.570	0	10	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
15	0.265	0	10	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
16	0.545	0	10	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
17	0.210	6	15	11	1	1	.	75	0	0.0	0.0	0	0.0	75.0	0	0.0
18	0.065	0	10	0	1	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
19	11	323	0	0	0	0.0	0.0	23.77	7.08	7.53	548	3.20	0.68	0.760
20	11	46	0	0	0	0.0	0.0	23.68	7.37	7.47	547	3.80	1.08	1.340
21	11	47	0	0	0	0.0	0.0	23.68	7.37	7.47	547	3.30	1.76	2.265
22	11	82	0	0	0	0.0	0.0	23.70	7.08	7.49	546	2.80	0.47	0.485
23	13	707	100	1	0	100.0	0.0	.	.	.	.	.	.	.
24	13	720	0	0	0	0.0	0.0	25.06	7.28	7.60	540	1.50	0.99	.
25	13	721	0	0	0	0.0	0.0	25.06	7.28	7.60	540	2.10	2.13	2.055
26	13	754	0	0	0	0.0	0.0	25.06	7.28	7.60	540	1.50	1.97	1.890
27	13	756	0	0	0	0.0	0.0	25.06	7.25	7.60	540	3.60	1.30	1.555
28	13	770	0	0	0	0.0	0.0	25.15	7.62	7.64	542	3.00	1.68	1.645
29	13	777	40	1	0	40.0	0.0	.	.	.	.	.	.	.
30	14	388E	30	1	0	30.0	0.0	25.59	6.93	7.67	542	1.70	0.03	0.010
31	14	416	0	0	0	0.0	0.0	25.35	7.29	7.69	543	3.30	0.58	0.660
32	14	461	0	0	0	0.0	0.0	25.33	7.01	7.65	543	4.20	.	0.020
33	14	515E	40	8	1	30.0	10.0	25.54	7.13	7.64	541	2.40	0.04	0.090
34	14	522	50	1	0	50.0	0.0	25.52	6.57	7.72	542	3.30	0.04	0.050
35	14	555	25	1	0	25.0	0.0	25.21	7.46	7.66	544	3.00	1.56	2.025
36	14	569E	0	0	0	0.0	0.0	25.21	7.46	7.66	544	3.00	2.14	2.320

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
19	2	4	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
20	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
21	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
22	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
23	4	15	7	1	3	.	0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
24	0	15	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
25	0	13	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
26	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
27	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
28	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
29	3	15	6	1	3	.	0	0.0	40.0	0.0	0	0.0	0.0	0.0	40.0
30	6	15	2	1	3	.	0	0.0	30.0	0.0	0	0.0	0.0	0.0	30.0
31	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
32	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
33	3	15	15	1	1	3	30	0.0	0.0	0.0	0	10.0	30.0	0.0	10.0
34	12	15	12	1	3	.	0	0.0	50.0	0.0	0	0.0	0.0	0.0	50.0
35	0	10	0	1	3	.	0	0.0	25.0	0.0	0	0.0	0.0	0.0	25.0
36	0	10	0	1	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
37	14	588E	100	1	0	100.0	0.0	25.30	7.40	7.62	545	1.50	0.09	0.080
38	14A	120	95	12	1	71.3	23.8	25.50	7.44	7.22	523	2.90	0.02	0.220
39	14A	20	20	1	0	20.0	0.0	25.30	8.06	7.79	551	1.62	0.03	0.010
40	14A	22	50	1	0	50.0	0.0	25.30	7.49	7.85	551	2.00	0.01	0.010
41	14A	57	80	17	0	60.0	20.0	25.40	7.64	7.70	555	1.10	0.59	0.540
42	14A	77	85	1	0	85.0	0.0	25.40	7.43	7.73	557	1.60	0.02	0.090
43	14B	13	0	0	0	0.0	0.0	25.58	7.77	7.66	557	0.50	.	1.770
44	14B	22	0	0	0	0.0	0.0	25.50	7.62	7.66	527	0.70	0.54	0.150
45	14B	23	0	0	0	0.0	0.0	25.50	7.72	7.68	558	1.75	0.82	1.030
46	15	118	50	1	0	50.0	0.0	25.63	8.21	7.72	560	1.95	0.47	0.660
47	15	159	90	12	1	67.5	22.5	25.76	8.27	7.75	554	0.90	.	0.020
48	15	26	90	1	0	90.0	0.0	25.54	7.44	7.67	560	3.90	0.03	0.250
49	15	33	100	17	6	75.0	25.0	26.25	7.61	7.70	564	1.00	0.04	0.020
50	16	124E	100	1	12	75.0	25.0	25.86	10.22	7.96	555	1.40	.	0.010
51	16	177	100	1	12	75.0	25.0	25.70	8.88	7.84	557	1.85	0.05	0.120
52	16	185	100	1	0	100.0	0.0	25.73	8.83	7.85	555	3.50	0.04	0.175
53	16	247	0	0	0	0.0	0.0	.	.	.	.	.	.	.
54	16	338	100	12	7	75.0	25.0	25.28	10.27	7.81	568	4.70	0.02	0.020

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
37	7	14	19	1	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
38	7	15	6	1	3	3	0.0	0.0	71.3	0.0	0	23.8	0.0	0.0	95.1
39	2	14	0	1	3	.	0.0	0.0	20.0	0.0	0	0.0	0.0	0.0	20.0
40	5	15	4	1	3	.	0.0	0.0	50.0	0.0	0	0.0	0.0	0.0	50.0
41	6	16	0	1	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0
42	7	15	2	1	3	.	0.0	0.0	85.0	0.0	0	0.0	0.0	0.0	85.0
43	1	15	0	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
44	1	15	0	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
45	2	15	1	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
46	6	15	4	1	3	.	0.0	0.0	50.0	0.0	0	0.0	0.0	0.0	50.0
47	10	15	8	1	3	3	0.0	0.0	67.5	0.0	0	22.5	0.0	0.0	90.0
48	5	15	2	1	3	.	0.0	0.0	90.0	0.0	0	0.0	0.0	0.0	90.0
49	6	15	8	1	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
50	8	15	12	1	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
51	7	15	0	1	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
52	8	15	9	1	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
53	7	15	4	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
54	10	15	98	1	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
55	16	404	100	7	0	75.0	25.0	26.30	10.63	7.95	563	4.60	0.04	0.045
56	16	434	100	1	7	75.0	25.0	25.71	10.24	7.75	573	3.30	0.05	0.040
57	17	157	100	1	0	100.0	0.0	24.95	7.20	7.63	567	2.80	0.10	0.055
58	17	311	100	1	8	75.0	25.0	25.17	5.06	7.56	577	2.60	0.03	0.020
59	17	33E	100	12	1	75.0	25.0	26.40	8.94	8.29	563	1.40	0.04	0.020
60	17	355	0	0	0	0.0	0.0	26.50	7.98	8.02	550	1.20	1.64	1.710
61	17	369E	30	1	0	30.0	0.0	26.60	7.17	7.98	552	1.25	0.55	0.590
62	3	104	0	0	0	0.0	0.0	24.12	4.70	7.25	559	3.60	0.11	0.155
63	3	108	0	0	0	0.0	0.0	24.12	4.61	7.28	558	3.60	0.22	0.050
64	3	124	50	5	8	37.5	12.5	23.94	4.47	7.29	557	3.10	0.01	0.055
65	3	136	90	1	0	90.0	0.0	24.32	4.94	7.34	555	3.80	.	0.085
66	3	140	60	1	0	60.0	0.0	24.28	5.03	7.32	551	4.00	0.02	0.110
67	3	149	0	0	0	0.0	0.0	24.25	4.95	7.31	558	3.00	0.14	0.155
68	3	153	0	0	0	0.0	0.0	24.17	4.94	7.26	559	3.20	0.11	0.160
69	3	25	0	0	0	0.0	0.0	24.17	4.54	7.36	559	5.30	0.09	0.075
70	3	27E	100	7	8	75.0	25.0	24.36	4.57	7.30	590	1.10	0.03	0.010
71	3	3	100	1	6	75.0	25.0	23.77	3.93	7.27	563	2.00	0.06	0.030
72	3	37	20	1	8	15.0	5.0	24.10	4.62	7.30	557	3.95	0.21	0.290

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
55	6	8	12	1	1	.	75.0	0.0	0.0	0.0	0	0.0	75.0	0.0	0.0
56	9	15	6	1	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
57	0	15	3	1	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
58	6	15	3	1	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
59	5	15	0	1	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
60	0	15	0	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
61	1	15	2	1	3	.	0.0	0.0	30.0	0.0	0	0.0	0.0	0.0	30.0
62	1	13	4	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
63	1	15	1	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
64	3	15	2	1	2	1	0.0	37.5	0.0	12.5	0	0.0	12.5	37.5	0.0
65	6	15	33	1	3	.	0.0	0.0	90.0	0.0	0	0.0	0.0	0.0	90.0
66	3	15	9	1	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0
67	3	15	3	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
68	7	15	45	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
69	0	3	0	1	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
70	1	7	0	1	1	1	75.0	0.0	0.0	25.0	0	0.0	100.0	0.0	0.0
71	5	15	3	1	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
72	2	3	0	1	3	1	0.0	0.0	15.0	5.0	0	0.0	5.0	0.0	15.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
73	3	5	30	6	1	22.5	7.5	23.87	3.90	7.30	554	3.90	0.02	0.060
74	3	54	60	1	8	45.0	15.0	24.03	4.28	7.29	560	2.70	0.04	0.075
75	3	71	40	1	0	40.0	0.0	24.12	4.58	7.31	557	3.50	0.03	0.140
76	3	78	70	1	0	70.0	0.0	24.10	4.64	7.29	558	3.90	0.08	0.265
77	3	81	60	1	0	60.0	0.0	24.07	4.54	7.30	559	3.40	0.10	0.275
78	3	87	90	1	0	90.0	0.0	24.03	4.56	7.31	557	4.10	0.04	0.160
79	3	96	20	8	1	15.0	5.0	24.07	4.45	7.28	557	4.00	.	0.130
80	3	98	70	8	0	52.5	17.5	24.19	4.62	7.25	559	3.20	0.24	0.070
81	4	100E	10	3	1	7.5	2.5	24.50	6.70	7.31	558	1.25	0.19	0.150
82	4	116E	70	5	3	52.5	17.5	23.54	6.48	7.31	555	3.15	0.09	0.285
83	4	130E	60	8	14	45.0	15.0	24.45	7.03	7.29	556	1.70	0.06	0.200
84	4	15	30	12	41	22.5	7.5	22.50	5.59	7.13	566	1.40	0.02	0.030
85	4	283E	20	6	12	15.0	5.0	24.50	4.50	7.26	558	1.90	0.03	0.050
86	4	323	80	12	6	60.0	20.0	24.50	5.14	7.28	558	2.40	0.07	0.045
87	4	33	100	1	8	75.0	25.0	23.87	7.02	7.20	562	2.95	0.03	0.015
88	4	344	80	8	8	60.0	20.0	24.21	5.69	7.38	560	3.10	.	0.070
89	4	44	60	8	1	45.0	15.0	24.80	6.83	7.30	556	0.82	0.04	0.050
90	4	47E	95	1	3	71.3	23.8	25.11	7.42	7.37	537	2.50	0.05	0.060

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
73	5	16	16	1	3	3	0.0	0.0	22.5	0.0	0	7.5	0.0	0.0	30.0
74	4	5	1	1	3	1	0.0	0.0	45.0	15.0	0	0.0	15.0	0.0	45.0
75	1	6	3	1	3	.	0.0	0.0	40.0	0.0	0	0.0	0.0	0.0	40.0
76	1	5	8	1	3	.	0.0	0.0	70.0	0.0	0	0.0	0.0	0.0	70.0
77	7	15	41	1	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0
78	5	15	13	1	3	.	0.0	0.0	90.0	0.0	0	0.0	0.0	0.0	90.0
79	3	15	22	1	1	3	15.0	0.0	0.0	0.0	0	5.0	15.0	0.0	5.0
80	5	15	9	1	1	.	52.5	0.0	0.0	0.0	0	0.0	52.5	0.0	0.0
81	4	15	1	1	1	3	7.5	0.0	0.0	0.0	0	2.5	7.5	0.0	2.5
82	5	15	5	1	2	1	0.0	52.5	0.0	17.5	0	0.0	17.5	52.5	0.0
83	3	15	8	1	1	3	45.0	0.0	0.0	0.0	0	15.0	45.0	0.0	15.0
84	5	9	25	1	3	3	0.0	0.0	22.5	0.0	0	7.5	0.0	0.0	30.0
85	5	15	10	1	3	3	0.0	0.0	15.0	0.0	0	5.0	0.0	0.0	20.0
86	6	15	7	1	3	3	0.0	0.0	60.0	0.0	0	20.0	0.0	0.0	80.0
87	11	12	21	1	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
88	7	15	13	1	1	1	60.0	0.0	0.0	20.0	0	0.0	80.0	0.0	0.0
89	7	14	27	1	1	3	45.0	0.0	0.0	0.0	0	15.0	45.0	0.0	15.0
90	6	15	12	1	3	1	0.0	0.0	71.3	23.8	0	0.0	23.8	0.0	71.3

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
91	4	483	10	1	0	10.0	0.0	23.90	6.13	7.33	558	2.70	0.47	0.505
92	4	528	40	6	3	30.0	10.0	23.88	5.88	7.24	557	2.90	0.01	0.030
93	4	573	75	1	3	56.3	18.8	23.85	5.62	7.26	556	3.60	0.17	0.135
94	4	574	30	3	0	22.5	7.5	23.79	5.63	7.28	555	4.30	0.20	0.455
95	4	609	5	9	0	3.8	1.3	23.85	6.10	7.25	554	3.10	0.37	0.345
96	5	117	100	8	0	75.0	25.0	24.10	6.11	7.31	557	2.80	0.03	0.030
97	5	141	100	5	0	75.0	25.0	23.45	5.19	7.23	556	3.50	0.02	0.220
98	5	162E	50	5	0	37.5	12.5	25.40	7.05	7.36	556	2.00	0.03	0.030
99	5	223	60	5	8	45.0	15.0	25.10	7.06	7.40	557	2.10	0.03	0.035
100	5	327E	50	5	8	37.5	12.5	23.70	5.30	7.31	559	2.70	0.02	0.015
101	5	50	70	5	8	52.5	17.5	24.00	6.14	7.32	556	2.50	0.01	0.220
102	5	80	100	6	8	75.0	25.0	25.30	7.18	7.53	557	2.40	0.10	0.070
103	5	85	100	8	0	75.0	25.0	24.00	6.01	7.31	557	2.90	0.03	0.020
104	5	91	100	5	0	75.0	25.0	24.00	6.14	7.22	556	3.30	.	0.100
105	8	109	90	8	0	67.5	22.5	26.40	8.70	7.53	554	2.20	0.06	0.050
106	8	161	100	5	0	75.0	25.0	23.70	6.42	7.36	556	4.20	0.02	0.240
107	8	337	100	8	5	75.0	25.0	23.90	7.15	7.31	555	3.70	0.05	0.125
108	8	367	100	5	0	75.0	25.0	25.30	8.53	7.39	555	1.60	0.02	0.020

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
91	3	15	1	1	3	.	0.0	0.0	10.0	0.0	0	0.0	0.0	0.0	10.0
92	4	15	5	1	3	1	0.0	0.0	30.0	10.0	0	0.0	10.0	0.0	30.0
93	3	15	0	1	3	1	0.0	0.0	56.3	18.8	0	0.0	18.8	0.0	56.3
94	3	15	0	1	1	.	22.5	0.0	0.0	0.0	0	0.0	22.5	0.0	0.0
95	2	15	0	1	1	.	3.8	0.0	0.0	0.0	0	0.0	3.8	0.0	0.0
96	5	16	24	1	1	.	75.0	0.0	0.0	0.0	0	0.0	75.0	0.0	0.0
97	4	15	2	1	2	.	0.0	75.0	0.0	0.0	0	0.0	0.0	75.0	0.0
98	7	15	0	1	2	.	0.0	37.5	0.0	0.0	0	0.0	0.0	37.5	0.0
99	4	15	4	1	2	1	0.0	45.0	0.0	15.0	0	0.0	15.0	45.0	0.0
100	4	15	0	1	2	1	0.0	37.5	0.0	12.5	0	0.0	12.5	37.5	0.0
101	4	15	13	1	2	1	0.0	52.5	0.0	17.5	0	0.0	17.5	52.5	0.0
102	7	15	11	1	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
103	4	15	21	1	1	.	75.0	0.0	0.0	0.0	0	0.0	75.0	0.0	0.0
104	5	15	19	1	2	.	0.0	75.0	0.0	0.0	0	0.0	0.0	75.0	0.0
105	6	15	5	1	1	.	67.5	0.0	0.0	0.0	0	0.0	67.5	0.0	0.0
106	4	15	2	1	2	.	0.0	75.0	0.0	0.0	0	0.0	0.0	75.0	0.0
107	8	15	9	1	1	2	75.0	0.0	0.0	0.0	25	0.0	75.0	25.0	0.0
108	5	15	12	1	2	.	0.0	75.0	0.0	0.0	0	0.0	0.0	75.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
109	8	459	0	0	0	0.0	0.0	23.23	7.300	7.18	544	1.20	0.05	0.140
110	9	156	0	0	0	0.0	0.0	24.72	7.220	7.20	543	2.00	0.15	0.270
111	9	342	60	14	41	45.0	15.0	24.78	6.880	7.19	544	1.00	0.04	0.050
112	9	389	100	14	1	75.0	25.0	24.87	6.750	7.20	543	2.00	0.02	0.040
113	9	42	100	5	0	75.0	25.0	24.62	7.250	7.23	545	2.00	0.02	0.150
114	9	457	95	5	0	71.3	23.8	24.83	7.380	7.19	545	1.70	0.05	0.100
115	9	516	50	1	0	50.0	0.0	24.89	7.120	7.21	543	2.00	0.01	0.040
116	9	553	100	14	0	75.0	25.0	24.78	7.380	7.22	542	2.60	0.08	0.880
117	9	585	50	8	0	37.5	12.5	25.05	7.770	7.20	544	2.00	0.04	0.050
118	1	101	100	2	0	100.0	0.0	19.17	12.720	7.41	532	2.90	.	0.030
119	1	142	5	6	0	5.0	0.0	22.50	8.820	7.22	535	2.50	0.05	.
120	1	172	100	1	2	75.0	25.0	23.45	6.300	7.02	534	1.80	0.02	.
121	1	28	5	6	0	5.0	0.0	13.97	10.710	7.52	529	1.10	.	.
122	1	51	5	10	0	5.0	0.0	18.50	9.380	7.38	537	1.20	.	.
123	1	55	70	17	6	52.5	17.5	.	.	.	.	1.50	.	.
124	1	6	0	0	0	0.0	0.0	11.00	15.610	7.93	488	2.50	.	.
125	10	10	0	0	0	0.0	0.0	20.80	6.730	7.23	575	3.68	0.08	0.025
126	10	140	0	0	0	0.0	0.0	23.90	8.720	7.31	540	2.85	0.31	0.880

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
109	3	15	1	1	.	.	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0
110	2	15	0	1	.	.	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0
111	5	14	1	1	3	3	0.0	0.0	45.0	0	0	15.0	0.0	0.0	60.0
112	4	15	0	1	3	3	0.0	0.0	75.0	0	0	25.0	0.0	0.0	100.0
113	2	15	0	1	2	.	0.0	75.0	0.0	0	0	0.0	0.0	75.0	0.0
114	5	15	10	1	2	.	0.0	71.3	0.0	0	0	0.0	0.0	71.3	0.0
115	4	15	6	1	3	.	0.0	0.0	50.0	0	0	0.0	0.0	0.0	50.0
116	3	15	8	1	3	.	0.0	0.0	75.0	0	0	0.0	0.0	0.0	75.0
117	4	15	8	1	1	.	37.5	0.0	0.0	0	0	0.0	37.5	0.0	0.0
118	5	10	0	2	3	.	0.0	0.0	100.0	0	0	0.0	0.0	0.0	100.0
119	4	9	1	2	3	.	0.0	0.0	5.0	0	0	0.0	0.0	0.0	5.0
120	5	15	15	2	3	3	0.0	0.0	75.0	0	0	25.0	0.0	0.0	100.0
121	2	10	0	2	3	.	0.0	0.0	5.0	0	0	0.0	0.0	0.0	5.0
122	0	10	0	2	1	.	5.0	0.0	0.0	0	0	0.0	5.0	0.0	0.0
123	4	10	0	2	3	3	0.0	0.0	52.5	0	0	17.5	0.0	0.0	70.0
124	0	7	0	2	.	.	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0
125	2	11	1	2	.	.	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0
126	0	8	0	2	.	.	0.0	0.0	0.0	0	0	0.0	0.0	0.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT
127	10	160	0	0	0	0.0	0.0	23.88	8.590	7.32	540	3.30	0.61
128	10	173	0	0	0	0.0	0.0	23.87	8.630	7.33	540	2.85	0.06
129	10	341	0	0	0	0.0	0.0	23.94	8.610	7.31	541	3.40	0.06
130	10	407	20	1	0	20.0	0.0	23.94	8.600	7.35	540	4.00	0.04
131	10	495	100	8	1	75.0	25.0	23.90	8.720	7.32	541	3.90	0.05
132	10	85	0	0	0	0.0	0.0	23.88	8.650	7.25	537	3.50	0.51
133	11	178	0	0	0	0.0	0.0	23.94	9.030	7.53	540	2.46	0.30
134	11	180	0	0	0	0.0	0.0	23.92	8.700	7.50	540	2.64	0.36
135	11	181	15	1	0	15.0	0.0	23.90	8.800	7.50	540	1.90	0.90
136	11	210	70	1	0	70.0	0.0	23.90	8.500	7.50	540	1.60	0.09
137	11	226	20	1	3	15.0	5.0	23.90	8.600	7.50	540	3.50	0.05
138	11	230	0	0	0	0.0	0.0	23.90	8.500	7.50	540	4.10	0.01
139	11	335	65	1	0	65.0	0.0	23.80	8.450	7.50	540	3.30	0.04
140	13	686	5	1	0	5.0	0.0	23.70	8.400	7.50	539	3.40	0.12
141	13	697	0	0	0	0.0	0.0	23.70	8.400	7.50	539	3.30	0.04
142	13	724	0	0	0	0.0	0.0	23.70	8.400	7.50	540	2.00	0.44
143	13	732	10	1	0	10.0	0.0	23.70	8.400	7.50	540	2.00	0.22
144	14	358	40	1	0	40.0	0.0	23.65	8.610	7.53	539	1.40	0.05

OBS	VAVG	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
127	0.710	1	8	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
128	0.190	0	7	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
129	0.090	1	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
130	0.255	1	10	0	2	3	.	0	0	20.0	0.0	0	0.0	0.0	0	20.0
131	0.375	9	16	9	2	1	3	75	0	0.0	0.0	0	25.0	75.0	0	25.0
132	0.815	1	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
133	0.780	0	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
134	0.400	0	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
135	1.010	1	10	0	2	3	.	0	0	15.0	0.0	0	0.0	0.0	0	15.0
136	0.120	6	15	0	2	3	.	0	0	70.0	0.0	0	0.0	0.0	0	70.0
137	0.100	6	14	4	2	3	1	0	0	15.0	5.0	0	0.0	5.0	0	15.0
138	0.035	3	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
139	0.395	7	15	3	2	3	.	0	0	65.0	0.0	0	0.0	0.0	0	65.0
140	0.200	1	10	0	2	3	.	0	0	5.0	0.0	0	0.0	0.0	0	5.0
141	0.110	1	15	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
142	0.520	1	10	0	2	.	.	0	0	0.0	0.0	0	0.0	0.0	0	0.0
143	0.210	1	10	0	2	3	.	0	0	10.0	0.0	0	0.0	0.0	0	10.0
144	0.050	5	15	3	2	3	.	0	0	40.0	0.0	0	0.0	0.0	0	40.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
145	14	378	5	1	0	5.0	0.0	23.65	8.610	7.53	539	2.40	0.20	0.285
146	14	392	50	1	0	50.0	0.0	23.68	8.720	7.60	539	3.30	0.04	1.480
147	14A	143	85	12	1	63.8	21.3	22.41	10.050	7.57	532	0.90	0.05	0.010
148	14A	9	0	0	0	0.0	0.0	23.29	11.540	7.63	523	0.90	0.22	0.380
149	14B	3	0	0	0	0.0	0.0	23.20	10.870	7.53	530	0.80	0.14	0.340
150	14B	33	0	0	0	0.0	0.0	22.78	9.250	7.57	533	0.48	.	0.090
151	15	158	50	1	12	37.5	12.5	22.37	8.950	7.62	533	2.00	0.05	0.100
152	15	16	85	12	1	63.8	21.3	22.57	11.100	7.61	530	2.00	0.02	0.020
153	15	30	100	12	0	100.0	0.0	22.59	10.220	7.57	531	0.80	1.41	0.540
154	15	76	100	1	37	75.0	25.0	22.43	10.180	7.59	525	1.70	0.22	0.270
155	16	152	100	7	1	75.0	25.0	21.20	11.650	7.72	533	2.40	0.02	0.020
156	16	225	100	7	1	75.0	25.0	21.27	10.411	7.67	534	2.10	0.02	0.090
157	16	260	100	7	0	100.0	0.0	20.57	11.250	7.69	533	1.10	0.03	0.030
158	16	266	100	7	1	75.0	25.0	21.22	10.320	7.69	533	2.72	0.09	0.105
159	16	547	75	7	0	75.0	0.0	20.80	9.830	7.21	563	2.82	.	0.005
160	16	550	100	1	0	100.0	0.0	17.65	11.500	7.71	538	3.00	0.03	0.030
161	16	568	100	1	12	75.0	25.0	17.86	11.660	7.71	540	2.00	.	0.020
162	16	643	15	1	0	15.0	0.0	19.52	9.610	7.45	551	1.80	0.03	0.021

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
145	0	10	0	2	3	.	0.0	0.0	5.0	0.0	0	0.0	0.0	0.0	5.0
146	5	15	1	2	3	.	0.0	0.0	50.0	0.0	0	0.0	0.0	0.0	50.0
147	4	15	1	2	3	3	0.0	0.0	63.8	0.0	0	21.3	0.0	0.0	85.1
148	1	10	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
149	3	10	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
150	2	9	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
151	8	15	0	2	3	3	0.0	0.0	37.5	0.0	0	12.5	0.0	0.0	50.0
152	7	15	3	2	3	3	0.0	0.0	63.8	0.0	0	21.3	0.0	0.0	85.1
153	4	15	0	2	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
154	7	15	2	2	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
155	5	10	6	2	1	3	75.0	0.0	0.0	0.0	0	25.0	75.0	0.0	25.0
156	4	12	5	2	1	3	75.0	0.0	0.0	0.0	0	25.0	75.0	0.0	25.0
157	8	12	8	2	1	.	100.0	0.0	0.0	0.0	0	0.0	100.0	0.0	0.0
158	2	12	6	2	1	3	75.0	0.0	0.0	0.0	0	25.0	75.0	0.0	25.0
159	0	10	0	2	1	.	75.0	0.0	0.0	0.0	0	0.0	75.0	0.0	0.0
160	4	12	4	2	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
161	5	15	0	2	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
162	5	10	0	2	3	.	0.0	0.0	15.0	0.0	0	0.0	0.0	0.0	15.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
163	17	371	0	0	0	0.0	0.0	18.71	10.62	7.51	553	0.80	.	0.040
164	17	375	0	0	0	0.0	0.0	18.95	10.15	7.58	550	1.80	0.07	0.060
165	17	378	10	1	0	10.0	0.0	19.00	11.14	7.59	550	2.00	0.20	0.310
166	17	382	10	1	0	10.0	0.0	19.00	10.19	7.58	550	0.70	0.41	0.320
167	17	393	0	0	0	0.0	0.0	18.98	.	.	.	3.60	0.20	0.360
168	17	51	70	1	0	70.0	0.0	19.67	11.00	7.54	546	1.85	.	.
169	17	81	100	1	0	100.0	0.0	19.70	11.00	7.54	546	2.00	0.04	0.060
170	3	101	100	1	0	100.0	0.0	23.63	5.83	7.04	547	3.70	.	0.205
171	3	111	15	1	8	11.3	3.8	23.57	6.30	7.08	546	3.70	.	0.010
172	3	39	90	1	8	67.5	22.5	23.57	7.11	7.13	544	1.40	0.06	0.011
173	3	47	95	1	12	71.3	23.8	23.63	7.44	7.13	540	1.80	0.06	0.140
174	3	49	70	1	8	52.5	17.5	23.63	6.31	7.07	545	2.30	0.03	0.070
175	3	70	100	1	12	75.0	25.0	23.48	6.52	7.09	547	2.20	.	.
176	3	75	65	1	0	65.0	0.0	23.65	5.66	7.03	545	2.60	.	0.075
177	3	83	60	1	0	60.0	0.0	23.65	6.51	7.03	545	4.40	.	0.050
178	4	11	80	8	7	60.0	20.0	23.47	8.64	7.19	544	3.00	.	0.020
179	4	118	100	14	7	75.0	25.0	23.30	6.80	7.05	545	2.40	.	.
180	4	170	0	0	0	0.0	0.0	23.03	5.96	7.00	538	3.20	0.29	0.600

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
163	2	10	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
164	3	10	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
165	1	9	0	2	3	.	0.0	0.0	10.0	0.0	0	0.0	0.0	0.0	10.0
166	0	10	0	2	3	.	0.0	0.0	10.0	0.0	0	0.0	0.0	0.0	10.0
167	1	11	1	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
168	6	14	8	2	3	.	0.0	0.0	70.0	0.0	0	0.0	0.0	0.0	70.0
169	3	10	6	2	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
170	7	15	11	2	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
171	6	15	15	2	3	1	0.0	0.0	11.3	3.8	0	0.0	3.8	0.0	11.3
172	6	15	1	2	3	1	0.0	0.0	67.5	22.5	0	0.0	22.5	0.0	67.5
173	6	15	13	2	3	3	0.0	0.0	71.3	0.0	0	23.8	0.0	0.0	95.1
174	7	14	1	2	3	1	0.0	0.0	52.5	17.5	0	0.0	17.5	0.0	52.5
175	9	15	1	2	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
176	3	15	4	2	3	.	0.0	0.0	65.0	0.0	0	0.0	0.0	0.0	65.0
177	2	10	0	2	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0
178	6	15	4	2	1	1	60.0	0.0	0.0	20.0	0	0.0	80.0	0.0	0.0
179	6	15	16	2	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
180	2	15	2	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
181	4	18	15	1	0	15.0	0.0	23.52	8.63	7.22	544	2.50	.	0.065
182	4	326	50	12	7	37.5	12.5	23.41	6.45	7.08	544	1.50	.	0.080
183	4	4	25	12	6	18.8	6.3	22.51	6.24	6.95	547	1.50	.	.
184	4	441	40	8	0	40.0	0.0	23.07	12.28	7.53	537	1.20	.	.
185	4	443	40	8	0	40.0	0.0	23.47	6.24	7.07	544	3.10	0.18	0.255
186	5	178	50	8	0	50.0	0.0	23.61	9.49	7.46	540	1.60	.	0.070
187	5	179	0	0	0	0.0	0.0	23.32	5.33	7.02	537	1.50	.	0.900
188	5	191	80	5	8	60.0	20.0	23.39	5.29	7.02	540	1.70	.	.
189	5	222	50	8	0	50.0	0.0	23.57	8.79	7.26	542	1.50	.	0.220
190	5	250	30	8	1	22.5	7.5	23.56	8.94	7.29	542	1.40	0.09	0.180
191	5	301	100	8	3	75.0	25.0	23.54	8.00	7.19	543	3.00	.	0.035
192	5	36	100	8	0	100.0	0.0	23.30	6.33	7.08	542	3.60	.	0.045
193	8	12	30	30	0	30.0	0.0	23.38	8.28	7.28	543	0.60	0.52	0.520
194	8	275	5	5	8	3.8	1.3	23.32	7.57	7.20	543	1.20	0.05	0.090
195	8	3	0	0	0	0.0	0.0	23.41	8.48	7.30	544	1.60	0.15	0.350
196	8	415	0	0	0	0.0	0.0	23.30	7.37	7.17	544	1.00	0.02	0.070
197	8	448	90	5	0	90.0	0.0	.	.	.	540	1.70	0.04	0.170
198	8	478	60	5	8	45.0	15.0	22.96	6.80	7.18	540	2.90	0.09	0.310

OBS	NUMSPEC	NUMPASS	DATER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
181	3	15	0	2	3	.	0.0	0.0	15.0	0.0	0	0.0	0.0	0.0	15.0
182	1	15	0	2	3	1	0.0	0.0	37.5	12.5	0	0.0	12.5	0.0	37.5
183	3	15	2	2	3	3	0.0	0.0	18.8	0.0	0	6.3	0.0	0.0	25.1
184	5	15	24	2	1	.	40.0	0.0	0.0	0.0	0	0.0	40.0	0.0	0.0
185	3	15	2	2	1	.	40.0	0.0	0.0	0.0	0	0.0	40.0	0.0	0.0
186	4	15	4	2	1	.	50.0	0.0	0.0	0.0	0	0.0	50.0	0.0	0.0
187	2	15	1	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
188	6	15	3	2	2	1	0.0	60.0	0.0	20.0	0	0.0	20.0	60.0	0.0
189	4	15	6	2	1	.	50.0	0.0	0.0	0.0	0	0.0	50.0	0.0	0.0
190	4	15	5	2	1	3	22.5	0.0	0.0	0.0	0	7.5	22.5	0.0	7.5
191	3	15	0	2	1	1	75.0	0.0	0.0	25.0	0	0.0	100.0	0.0	0.0
192	5	15	3	2	1	.	100.0	0.0	0.0	0.0	0	0.0	100.0	0.0	0.0
193	2	15	1	2	1	.	30.0	0.0	0.0	0.0	0	0.0	30.0	0.0	0.0
194	6	15	1	2	2	1	0.0	3.8	0.0	1.3	0	0.0	1.3	3.8	0.0
195	2	15	1	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
196	3	15	0	2	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
197	4	15	1	2	2	.	0.0	90.0	0.0	0.0	0	0.0	0.0	90.0	0.0
198	3	15	0	2	2	1	0.0	45.0	0.0	15.0	0	0.0	15.0	45.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
199	9	11	100	14	5	75.0	25.0	24.01	5.40	6.95	545	3.90	0.02	0.180
200	9	203	0	0	0	0.0	0.0	23.99	5.43	6.98	540	3.70	0.80	1.455
201	9	244	75	14	8	56.3	18.8	24.05	5.42	7.02	540	2.60	0.16	.
202	9	290	90	14	0	90.0	0.0	23.97	5.36	7.04	541	2.00	0.05	0.620
203	9	30	10	5	0	10.0	0.0	23.97	5.29	6.97	541	2.50	1.07	1.330
204	9	314	75	14	1	56.3	18.8	23.97	5.32	7.05	540	2.70	0.02	0.280
205	9	336	60	14	0	60.0	0.0	23.97	5.38	7.06	540	1.50	0.02	0.440
206	9	54	100	5	14	75.0	25.0	23.97	5.17	6.98	539	1.80	.	0.680
207	1	119	100	2	6	75.0	25.0	21.50	10.83	7.33	495	3.20	0.02	0.030
208	1	143	100	8	6	75.0	25.0	22.66	8.20	7.25	514	1.80	0.03	0.040
209	1	154	100	2	8	75.0	25.0	22.94	9.10	7.29	520	2.30	0.03	.
210	1	173	95	1	0	95.0	0.0	23.36	6.83	7.20	526	2.00	0.03	0.040
211	1	98	70	10	0	70.0	0.0	20.71	9.84	7.40	495	3.00	0.02	0.010
212	10	29	0	0	0	0.0	0.0	21.25	9.15	7.46	548	2.50	.	.
213	10	395	70	8	1	52.5	17.5	22.76	9.25	7.45	528	1.50	0.06	0.060
214	10	456	100	1	0	100.0	0.0	22.78	8.70	7.47	528	1.90	0.02	0.130
215	10	477	100	8	1	75.0	25.0	22.78	8.70	7.44	525	4.00	.	0.225
216	10	495	100	1	16	75.0	25.0	24.17	8.38	7.87	550	3.60	0.39	0.520

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
199	7	15	1	2	3	2	0.0	0	75.0	0.0	25	0.0	0.0	25	75.0
200	1	15	0	2	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
201	3	15	0	2	3	1	0.0	0	56.3	18.8	0	0.0	18.8	0	56.3
202	4	15	1	2	3	.	0.0	0	90.0	0.0	0	0.0	0.0	0	90.0
203	0	10	0	2	2	.	0.0	10	0.0	0.0	0	0.0	0.0	10	0.0
204	5	15	4	2	3	3	0.0	0	56.3	0.0	0	18.8	0.0	0	75.1
205	1	15	0	2	3	.	0.0	0	60.0	0.0	0	0.0	0.0	0	60.0
206	2	15	0	2	2	3	0.0	75	0.0	0.0	0	25.0	0.0	75	25.0
207	4	15	0	3	3	3	0.0	0	75.0	0.0	0	25.0	0.0	0	100.0
208	5	15	0	3	1	3	75.0	0	0.0	0.0	0	25.0	75.0	0	25.0
209	3	15	0	3	3	1	0.0	0	75.0	25.0	0	0.0	25.0	0	75.0
210	4	15	1	3	3	.	0.0	0	95.0	0.0	0	0.0	0.0	0	95.0
211	7	15	1	3	1	.	70.0	0	0.0	0.0	0	0.0	70.0	0	0.0
212	3	10	0	3	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
213	6	11	2	3	1	3	52.5	0	0.0	0.0	0	17.5	52.5	0	17.5
214	5	15	6	3	3	.	0.0	0	100.0	0.0	0	0.0	0.0	0	100.0
215	7	15	23	3	1	3	75.0	0	0.0	0.0	0	25.0	75.0	0	25.0
216	5	15	13	3	3	2	0.0	0	75.0	0.0	25	0.0	0.0	25	75.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
217	10	525	90	14	3	67.5	22.5	22.76	8.63	7.45	526	3.50	0.03	0.360
218	10	530	75	8	1	56.3	18.8	24.13	8.34	7.88	549	3.50	.	0.090
219	11	153	0	0	0	0.0	0.0	22.47	9.28	7.51	524	2.00	0.14	0.270
220	11	189	80	1	7	60.0	20.0	22.45	8.23	7.54	524	2.30	0.02	0.040
221	11	193	100	1	3	75.0	25.0	22.45	8.23	7.54	524	3.00	0.03	0.025
222	11	277	0	0	0	0.0	0.0	22.44	9.77	7.53	526	3.00	0.43	0.485
223	11	281	0	0	0	0.0	0.0	22.44	9.77	.	.	2.50	0.33	0.350
224	14	353	100	7	24	75.0	25.0	23.36	8.74	7.66	527	1.50	0.11	0.080
225	14	519	15	3	7	11.3	3.8	23.36	8.59	7.65	525	1.30	0.03	0.030
226	14	549	0	0	0	0.0	0.0	22.36	8.74	7.70	525	2.00	.	0.130
227	14	553	80	1	0	80.0	0.0	22.36	8.74	7.70	525	2.20	0.05	0.030
228	14	559	0	0	0	0.0	0.0	22.36	8.74	7.70	525	3.80	0.97	1.240
229	14A	100	90	12	1	67.5	22.5	21.95	10.37	7.69	527	0.40	.	0.010
230	14A	4	0	0	0	0.0	0.0	22.19	10.28	7.72	522	0.75	.	0.230
231	14A	75	90	1	0	90.0	0.0	21.95	10.37	7.69	527	1.50	0.06	0.080
232	14A	92	50	1	6	37.5	12.5	.	.	.	.	1.60	.	0.050
233	14B	15	0	0	0	0.0	0.0	22.25	9.24	7.65	521	0.30	.	1.280
234	15	111	60	1	0	60.0	0.0	21.68	9.98	7.64	526	0.60	.	0.080

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCLLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
217	3	15	17	3	3	1	0.0	0.0	67.5	22.5	0	0.0	22.5	0.0	67.5
218	5	15	24	3	1	3	56.3	0.0	0.0	0.0	0	18.8	56.3	0.0	18.8
219	0	10	0	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
220	3	15	23	3	3	1	0.0	0.0	60.0	20.0	0	0.0	20.0	0.0	60.0
221	9	15	9	3	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
222	0	10	0	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
223	0	10	0	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
224	0	10	0	3	1	1	75.0	0.0	0.0	25.0	0	0.0	100.0	0.0	0.0
225	2	12	0	3	1	1	11.3	0.0	0.0	3.8	0	0.0	15.1	0.0	0.0
226	6	10	2	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
227	3	15	6	3	3	.	0.0	0.0	80.0	0.0	0	0.0	0.0	0.0	80.0
228	0	10	0	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
229	2	14	1	3	3	3	0.0	0.0	67.5	0.0	0	22.5	0.0	0.0	90.0
230	3	11	1	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
231	4	10	9	3	3	.	0.0	0.0	90.0	0.0	0	0.0	0.0	0.0	90.0
232	3	10	7	3	3	3	0.0	0.0	37.5	0.0	0	12.5	0.0	0.0	50.0
233	1	10	0	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
234	2	10	0	3	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
235	15	130	0	0	0	0.0	0.0	20.50	6.20	7.25	498	.	.	.
236	15	24	10	12	1	7.5	2.5	21.35	7.16	7.70	524	0.60	.	0.020
237	15	60	30	0	0	30.0	0.0	21.68	9.98	7.64	526	0.70	.	1.130
238	15	93	100	5	0	100.0	0.0	21.68	9.98	7.64	526	1.20	.	0.310
239	16	107	0	0	0	0.0	0.0	22.23	7.72	7.70	528	3.40	0.02	0.070
240	16	17	2	1	0	2.0	0.0	22.37	6.57	7.70	522	0.90	0.28	0.170
241	16	191	0	0	0	0.0	0.0	21.98	7.34	7.67	527	1.80	0.02	0.040
242	16	215	0	0	0	0.0	0.0	21.96	6.83	7.64	528	3.00	0.10	0.130
243	16	477	0	0	0	0.0	0.0	21.40	6.71	7.47	525	3.20	0.02	0.025
244	17	304	100	1	8	75.0	25.0	20.26	6.63	7.50	528	1.90	0.04	0.020
245	17	336	0	0	0	0.0	0.0	23.38	9.12	7.93	542	0.20	.	0.810
246	17	362	100	1	8	75.0	25.0	19.98	8.11	7.59	506	2.00	0.04	0.030
247	17	393	100	1	8	75.0	25.0	20.16	7.34	7.59	528	1.70	0.03	0.090
248	17	92	100	1	7	75.0	25.0	20.07	7.63	7.51	526	3.60	0.03	0.030
249	17	94	100	1	0	100.0	0.0	20.07	7.63	7.51	526	2.40	0.12	0.120
250	3	103	95	1	0	95.0	0.0	23.43	6.30	7.19	527	3.20	.	0.150
251	3	110	95	1	0	95.0	0.0	23.45	5.32	7.13	528	2.80	0.06	0.050
252	3	118	90	16	3	67.5	22.5	23.12	5.36	7.10	529	2.40	0.01	0.030

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
235	0	10	0	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
236	3	15	4	3	3	3	0	0.0	7.5	0.0	0	2.5	0.0	0.0	10.0
237	2	15	2	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
238	3	15	0	3	2	.	0	100.0	0.0	0.0	0	0.0	0.0	100.0	0.0
239	2	15	20	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
240	3	15	6	3	3	.	0	0.0	2.0	0.0	0	0.0	0.0	0.0	2.0
241	3	15	20	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
242	1	15	6	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
243	1	15	2	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
244	3	14	0	3	3	1	0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
245	1	10	1	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
246	3	15	0	3	3	1	0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
247	3	10	1	3	3	1	0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
248	2	10	3	3	3	1	0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
249	3	10	15	3	3	.	0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
250	3	15	11	3	3	.	0	0.0	95.0	0.0	0	0.0	0.0	0.0	95.0
251	6	13	3	3	3	.	0	0.0	95.0	0.0	0	0.0	0.0	0.0	95.0
252	4	15	3	3	2	1	0	67.5	0.0	22.5	0	0.0	22.5	67.5	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
253	3	127	90	16	3	67.5	22.5	23.18	5.52	7.07	526	2.20	0.01	0.070
254	3	130	70	1	11	52.5	17.5	23.20	7.69	7.29	526	2.40	0.02	0.030
255	3	76	90	1	0	90.0	0.0	23.39	5.98	7.13	526	2.90	0.02	0.185
256	3	82	100	8	0	100.0	0.0	23.36	6.30	7.17	527	2.40	0.02	.
257	3	96	95	1	0	95.0	0.0	23.50	5.56	7.11	526	3.90	0.02	0.130
258	4	171	5	14	3	3.8	1.3	23.13	6.06	7.10	525	2.00	.	.
259	4	219	50	14	1	37.5	12.5	23.67	4.87	7.11	525	2.50	.	0.010
260	4	322	100	12	6	75.0	25.0	22.99	6.40	7.28	525	2.00	.	0.010
261	4	49	60	3	0	60.0	0.0	23.07	7.10	7.24	526	3.00	0.04	0.175
262	4	72	5	30	0	5.0	0.0	22.55	6.09	7.00	525	2.50	0.02	0.020
263	4	83	10	1	0	10.0	0.0	22.76	6.69	7.21	527	0.35	.	.
264	5	1	30	8	0	30.0	0.0	21.39	9.41	7.71	520	1.30	0.01	0.010
265	5	235	90	5	0	90.0	0.0	23.32	5.71	7.17	.	1.80	0.01	0.020
266	5	249	95	5	0	95.0	0.0	23.22	5.71	7.17	523	3.50	0.01	0.070
267	5	276	40	1	8	30.0	10.0	22.41	8.08	7.36	525	1.30	0.09	0.090
268	5	316	90	5	0	90.0	0.0	22.95	5.93	7.19	524	2.10	.	.
269	5	43	100	8	0	100.0	0.0	21.39	9.40	7.70	520	1.65	.	0.010
270	8	143	0	0	0	0.0	0.0	22.69	8.17	7.38	519	0.90	.	0.090

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
253	8	13	3	3	2	1	0	67.5	0.0	22.5	0	0.0	22.5	67.5	0.0
254	4	10	1	3	3	.	0	0.0	52.5	0.0	0	0.0	0.0	0.0	52.5
255	3	15	0	3	3	.	0	0.0	90.0	0.0	0	0.0	0.0	0.0	90.0
256	4	14	12	3	1	.	100	0.0	0.0	0.0	0	0.0	100.0	0.0	0.0
257	4	15	9	3	3	.	0	0.0	95.0	0.0	0	0.0	0.0	0.0	95.0
258	2	13	1	3	3	1	0	0.0	3.8	1.3	0	0.0	1.3	0.0	3.8
259	5	15	49	3	3	3	0	0.0	37.5	0.0	0	12.5	0.0	0.0	50.0
260	4	10	2	3	3	3	0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
261	4	15	0	3	1	.	60	0.0	0.0	0.0	0	0.0	60.0	0.0	0.0
262	2	12	1	3	1	.	5	0.0	0.0	0.0	0	0.0	5.0	0.0	0.0
263	5	15	2	3	3	.	0	0.0	10.0	0.0	0	0.0	0.0	0.0	10.0
264	5	15	4	3	1	.	30	0.0	0.0	0.0	0	0.0	30.0	0.0	0.0
265	2	15	0	3	2	.	0	90.0	0.0	0.0	0	0.0	0.0	90.0	0.0
266	4	15	0	3	2	.	0	95.0	0.0	0.0	0	0.0	0.0	95.0	0.0
267	2	15	2	3	3	1	0	0.0	30.0	10.0	0	0.0	10.0	0.0	30.0
268	5	15	1	3	2	.	0	90.0	0.0	0.0	0	0.0	0.0	90.0	0.0
269	4	15	11	3	1	.	100	0.0	0.0	0.0	0	0.0	100.0	0.0	0.0
270	2	15	0	3	.	.	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
271	8	260	10	0	0	10.0	0.0	22.93	9.26	7.39	520	1.90	0.13	0.070
272	8	449	50	5	55	37.5	12.5	22.85	8.63	7.40	524	1.50	.	0.020
273	8	468	20	5	8	15.0	5.0	22.89	9.14	7.41	520	1.90	0.53	0.520
274	8	85	5	8	0	5.0	0.0	22.71	10.78	7.38	523	0.90	.	0.040
275	8	96	70	5	0	70.0	0.0	23.07	6.52	7.26	523	1.50	0.66	0.070
276	9	202	40	14	5	30.0	10.0	22.80	7.43	7.29	518	2.20	0.29	0.250
277	9	376	50	14	0	50.0	0.0	22.98	7.51	7.31	524	2.10	0.31	0.240
278	9	468	80	5	0	80.0	0.0	22.89	7.81	7.31	523	1.70	0.12	0.070
279	9	50	95	5	0	95.0	0.0	24.33	8.68	7.65	548	1.40	0.09	0.090
280	9	511	5	16	0	5.0	0.0	22.91	7.23	7.29	523	2.40	0.05	0.060
281	1	21	10	6	51	7.5	2.5	.	.	.	.	0.50	.	.
282	1	32	0	0	0	0.0	0.0	.	.	.	.	0.30	.	.
283	1	54	75	6	10	56.3	18.8	.	.	.	.	1.30	.	.
284	1	72	100	51	6	75.0	25.0	.	.	.	.	2.20	.	.
285	1	93	100	2	6	75.0	25.0	.	.	.	.	2.10	.	.
286	10	186	100	1	0	100.0	0.0	24.50	.	.	.	2.00	0.09	0.760
287	10	217	10	7	0	10.0	0.0	24.50	.	.	.	2.90	0.20	0.225
288	10	25	0	0	0	0.0	0.0	24.50	5.22	7.78	576	3.10	0.05	0.050

OBS	NUMSPEC	NUMPASS	DARTERD	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
271	3	15	1	3	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
272	4	15	2	3	2	3	0.0	37.5	0.0	0.0	0	12.5	0.0	37.5	12.5
273	2	15	1	3	2	1	0.0	15.0	0.0	5.0	0	0.0	5.0	15.0	0.0
274	3	13	5	3	1	.	5.0	0.0	0.0	0.0	0	0.0	5.0	0.0	0.0
275	2	15	2	3	2	.	0.0	70.0	0.0	0.0	0	0.0	0.0	70.0	0.0
276	3	15	0	3	3	2	0.0	0.0	30.0	0.0	10	0.0	0.0	10.0	30.0
277	2	15	0	3	3	.	0.0	0.0	50.0	0.0	0	0.0	0.0	0.0	50.0
278	4	15	3	3	2	.	0.0	80.0	0.0	0.0	0	0.0	0.0	80.0	0.0
279	3	15	1	3	2	.	0.0	95.0	0.0	0.0	0	0.0	0.0	95.0	0.0
280	2	15	0	3	2	.	0.0	5.0	0.0	0.0	0	0.0	0.0	5.0	0.0
281	2	10	0	4	3	3	0.0	0.0	7.5	0.0	0	2.5	0.0	0.0	10.0
282	2	10	1	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
283	2	10	0	4	3	1	0.0	0.0	56.3	18.8	0	0.0	18.8	0.0	56.3
284	3	10	1	4	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
285	7	15	1	4	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
286	1	15	0	4	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
287	2	15	0	4	1	.	10.0	0.0	0.0	0.0	0	0.0	10.0	0.0	0.0
288	2	15	2	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
289	10	505	100	1	0	100.0	0.0	25.50	.	.	.	2.80	0.05	0.270
290	11	162	20	7	1	15.0	5.0	24.33	7.94	7.76	539	1.10	.	0.080
291	11	169	0	0	0	0.0	0.0	24.24	8.13	7.75	539	2.00	0.73	1.260
292	11	211	10	7	0	10.0	0.0	24.39	7.73	7.77	540	2.00	0.09	0.110
293	11	234	100	7	1	75.0	25.0	24.35	7.54	7.77	539	2.80	0.03	0.020
294	11	257	0	0	0	0.0	0.0	24.33	7.72	7.77	539	2.90	0.04	0.160
295	11	340	0	0	0	0.0	0.0	24.38	7.95	7.77	538	2.20	0.68	0.670
296	14	463	90	1	3	67.5	22.5	24.49	8.09	7.80	538	1.50	0.02	0.010
297	14	475	80	1	7	60.0	20.0	24.49	8.09	7.80	538	1.20	0.02	0.030
298	14	492	0	0	0	0.0	0.0	24.50	8.40	7.81	537	1.80	0.01	0.020
299	14	500	70	1	7	52.5	17.5	24.50	8.40	7.81	537	1.10	0.01	0.020
300	14	540	80	3	1	60.0	20.0	24.42	7.50	7.82	538	1.30	0.10	0.100
301	14	609	95	1	7	71.3	23.8	24.42	7.74	7.80	539	0.80	0.06	0.010
302	14A	127	50	12	14	37.5	12.5	23.84	7.82	7.66	542	1.80	0.02	0.030
303	14A	135	10	12	0	10.0	0.0	23.54	6.16	7.45	545	2.60	0.05	0.070
304	14A	31	10	9	1	7.5	2.5	24.09	7.70	7.65	542	0.60	.	1.910
305	14A	7	40	1	0	40.0	0.0	23.83	7.70	7.75	540	1.80	0.25	0.024
306	14B	16	0	0	0	0.0	0.0	24.70	7.79	7.66	542	0.50	.	0.870

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCLS	SVEGCLS	DCOMM1	DCOMM2	DCOMM3	SCOMM1	SCOMM2	SCOMM3	VEGCOMM1	VEGCOMM2	VEGCOMM3
289	6	15	17	4	3	.	0.0	0	100.0	0.0	0	0.0	0.0	0	100.0
290	2	15	1	4	1	3	15.0	0	0.0	0.0	0	5.0	15.0	0	5.0
291	0	10	0	4	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
292	3	15	8	4	1	.	10.0	0	0.0	0.0	0	0.0	10.0	0	0.0
293	8	15	27	4	1	3	75.0	0	0.0	0.0	0	25.0	75.0	0	25.0
294	0	10	0	4	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
295	2	15	4	4	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
296	7	14	9	4	3	1	0.0	0	67.5	22.5	0	0.0	22.5	0	67.5
297	6	10	5	4	3	1	0.0	0	60.0	20.0	0	0.0	20.0	0	60.0
298	8	9	9	4	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
299	6	10	14	4	3	1	0.0	0	52.5	17.5	0	0.0	17.5	0	52.5
300	3	15	19	4	1	3	60.0	0	0.0	0.0	0	20.0	60.0	0	20.0
301	8	12	2	4	3	1	0.0	0	71.3	23.8	0	0.0	23.8	0	71.3
302	6	15	6	4	3	3	0.0	0	37.5	0.0	0	12.5	0.0	0	50.0
303	3	10	0	4	3	.	0.0	0	10.0	0.0	0	0.0	0.0	0	10.0
304	2	10	0	4	1	3	7.5	0	0.0	0.0	0	2.5	7.5	0	2.5
305	5	15	3	4	3	.	0.0	0	40.0	0.0	0	0.0	0.0	0	40.0
306	3	13	0	4	.	.	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
307	14B	21	0	0	0	0.0	0.0	24.70	7.79	7.66	542	0.80	.	0.780
308	15	106	80	5	0	80.0	0.0	23.80	7.90	7.67	542	1.15	0.27	0.240
309	15	121	80	5	0	80.0	0.0	23.88	8.07	7.70	542	0.80	2.05	2.120
310	15	13	70	12	1	52.5	17.5	23.97	7.57	7.62	543	1.20	0.03	0.010
311	15	154	70	12	1	52.5	17.5	23.90	7.70	7.77	542	1.40	0.05	.
312	15	168	25	1	12	18.8	6.3	23.89	8.25	7.75	542	0.70	0.64	0.200
313	15	81	35	1	0	35.0	0.0	23.93	7.80	7.67	542	0.70	.	0.580
314	16	178	10	7	0	10.0	0.0	24.00	8.17	7.76	541	2.30	.	0.020
315	16	281	0	0	0	0.0	0.0	23.91	8.10	7.77	541	2.10	0.05	0.060
316	16	415	25	6	0	25.0	0.0	23.84	8.75	7.70	541	2.30	0.04	0.030
317	16	592	0	0	0	0.0	0.0	23.01	8.05	7.89	542	2.70	0.07	0.310
318	16	8	25	1	7	18.8	6.3	24.65	8.37	7.79	538	0.95	0.02	0.030
319	16	99	25	7	0	25.0	0.0	24.20	8.53	7.75	539	2.10	0.04	0.050
320	17	19	60	1	0	60.0	0.0	23.60	8.35	7.65	548	1.60	0.04	0.050
321	17	298	70	1	0	70.0	0.0	23.46	9.63	7.86	542	2.70	0.04	0.050
322	17	358	0	0	0	0.0	0.0	23.40	9.10	7.94	541	1.90	1.71	1.720
323	17	391	70	1	8	52.5	17.5	23.40	8.64	7.93	542	1.00	0.05	0.090
324	17	76	75	1	0	75.0	0.0	23.84	8.55	7.73	545	1.90	0.03	.

OBS	NUMSPEC	NUMPASS	DATER	PERIOD	DVEGCLS	SVEGCLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
307	1	12	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
308	1	15	0	4	2	.	0.0	80.0	0.0	0.0	0	0.0	0.0	80.0	0.0
309	0	10	0	4	2	.	0.0	80.0	0.0	0.0	0	0.0	0.0	80.0	0.0
310	6	15	15	4	3	3	0.0	0.0	52.5	0.0	0	17.5	0.0	0.0	70.0
311	4	15	1	4	3	3	0.0	0.0	52.5	0.0	0	17.5	0.0	0.0	70.0
312	5	15	4	4	3	3	0.0	0.0	18.8	0.0	0	6.3	0.0	0.0	25.1
313	1	15	0	4	3	.	0.0	0.0	35.0	0.0	0	0.0	0.0	0.0	35.0
314	2	15	7	4	1	.	10.0	0.0	0.0	0.0	0	0.0	10.0	0.0	0.0
315	3	15	5	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
316	6	15	1	4	3	.	0.0	0.0	25.0	0.0	0	0.0	0.0	0.0	25.0
317	1	15	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
318	4	15	3	4	3	1	0.0	0.0	18.8	6.3	0	0.0	6.3	0.0	18.8
319	4	15	20	4	1	.	25.0	0.0	0.0	0.0	0	0.0	25.0	0.0	0.0
320	1	10	0	4	3	.	0.0	0.0	60.0	0.0	0	0.0	0.0	0.0	60.0
321	5	13	8	4	3	.	0.0	0.0	70.0	0.0	0	0.0	0.0	0.0	70.0
322	1	10	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
323	4	10	0	4	3	1	0.0	0.0	52.5	17.5	0	0.0	17.5	0.0	52.5
324	3	10	2	4	3	.	0.0	0.0	75.0	0.0	0	0.0	0.0	0.0	75.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
325	3	107	100	1	0	100.0	0.0	23.92	7.11	7.55	553	2.50	.	0.005
326	3	126	95	1	0	95.0	0.0	23.94	7.40	7.57	553	3.10	.	0.055
327	3	15	0	0	0	0.0	0.0	23.75	5.96	7.33	543	3.60	0.04	0.055
328	3	58	80	1	0	80.0	0.0	23.72	5.74	7.50	553	0.60	0.03	0.040
329	3	6	100	6	1	75.0	25.0	23.65	4.90	7.28	545	3.30	0.04	0.015
330	3	68	100	1	8	75.0	25.0	23.72	5.74	7.50	553	4.00	0.01	0.140
331	4	193	90	14	3	67.5	22.5	23.82	7.73	7.57	549	1.40	0.10	0.100
332	4	21	60	8	7	45.0	15.0	23.20	5.13	7.41	554	1.40	0.06	0.060
333	4	26	95	1	8	71.3	23.8	22.46	5.95	7.33	556	1.00	0.04	0.020
334	4	394	95	8	7	71.3	23.8	24.84	9.54	7.91	538	0.80	0.04	.
335	4	419	100	8	0	100.0	0.0	24.20	8.85	7.63	550	2.50	0.06	0.020
336	4	50	50	8	8	37.5	12.5	23.68	5.63	7.49	553	1.60	0.02	.
337	5	105	20	1	0	20.0	0.0	23.88	6.57	7.53	551	2.70	0.07	0.080
338	5	146	60	8	0	60.0	0.0	25.70	11.59	7.86	547	1.60	0.05	0.130
339	5	151	100	1	0	100.0	0.0	23.86	6.95	7.49	551	2.00	0.09	0.040
340	5	289	35	8	1	26.3	8.8	24.75	8.67	7.65	550	1.30	0.09	0.090
341	5	300	85	5	0	85.0	0.0	23.43	5.67	7.50	550	2.90	0.01	0.200
342	5	61	80	8	6	60.0	20.0	25.77	11.52	7.86	546	0.80	0.03	0.020

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
325	7	15	6	4	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
326	2	15	0	4	3	.	0.0	0.0	95.0	0.0	0	0.0	0.0	0.0	95.0
327	0	10	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
328	1	10	0	4	3	.	0.0	0.0	80.0	0.0	0	0.0	0.0	0.0	80.0
329	2	15	1	4	3	3	0.0	0.0	75.0	0.0	0	25.0	0.0	0.0	100.0
330	3	15	8	4	3	1	0.0	0.0	75.0	25.0	0	0.0	25.0	0.0	75.0
331	6	15	22	4	3	1	0.0	0.0	67.5	22.5	0	0.0	22.5	0.0	67.5
332	5	15	1	4	1	1	45.0	0.0	0.0	15.0	0	0.0	60.0	0.0	0.0
333	6	15	7	4	3	1	0.0	0.0	71.3	23.8	0	0.0	23.8	0.0	71.3
334	3	15	6	4	1	1	71.3	0.0	0.0	23.8	0	0.0	95.1	0.0	0.0
335	5	15	11	4	1	.	100.0	0.0	0.0	0.0	0	0.0	100.0	0.0	0.0
336	6	16	14	4	1	1	37.5	0.0	0.0	12.5	0	0.0	50.0	0.0	0.0
337	2	15	11	4	3	.	0.0	0.0	20.0	0.0	0	0.0	0.0	0.0	20.0
338	4	15	5	4	1	.	60.0	0.0	0.0	0.0	0	0.0	60.0	0.0	0.0
339	5	15	6	4	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0
340	2	15	1	4	1	3	26.3	0.0	0.0	0.0	0	8.8	26.3	0.0	8.8
341	4	15	2	4	2	.	0.0	85.0	0.0	0.0	0	0.0	0.0	85.0	0.0
342	5	15	4	4	1	3	60.0	0.0	0.0	0.0	0	20.0	60.0	0.0	20.0

OBS	STRATA	GRID	PERVEG	DOMVEG	SUBVEG	PERDV	PERSV	TEMP	DO	PH	SC	DEPTH	VBOT	VAVG
343	8	190	85	5	0	85.0	0.0	23.51	6.56	7.61	549	3.40	0.01	0.015
344	8	247	0	0	0	0.0	0.0	24.38	7.87	7.62	550	2.40	0.03	0.050
345	8	341	0	0	0	0.0	0.0	23.60	7.21	7.66	544	0.80	0.04	.
346	8	39	25	17	0	25.0	0.0	24.87	8.85	7.70	549	1.40	0.30	0.300
347	8	391	5	30	0	5.0	0.0	23.72	8.15	7.65	547	1.30	0.22	0.220
348	8	496	90	5	7	67.5	22.5	24.38	8.73	7.62	549	1.80	0.02	0.050
349	9	210	10	0	0	10.0	0.0	23.35	5.25	7.57	552	1.20	0.04	0.040
350	9	248	40	1	14	30.0	10.0	23.36	5.24	7.58	551	1.70	.	0.300
351	9	311	0	0	0	0.0	0.0	23.36	5.30	7.57	552	0.40	.	0.080
352	9	360	100	14	0	100.0	0.0	23.35	5.11	7.56	552	2.60	0.05	0.060

OBS	NUMSPEC	NUMPASS	DARTER	PERIOD	DVEGCOLS	SVEGCOLS	DCOM1	DCOM2	DCOM3	SCOM1	SCOM2	SCOM3	VEGCOM1	VEGCOM2	VEGCOM3
343	3	15	4	4	2	.	0.0	85.0	0.0	0.0	0	0.0	0.0	85.0	0.0
344	1	15	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
345	2	15	3	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
346	4	15	10	4	3	.	0.0	0.0	25.0	0.0	0	0.0	0.0	0.0	25.0
347	3	15	6	4	1	.	5.0	0.0	0.0	0.0	0	0.0	5.0	0.0	0.0
348	6	14	8	4	2	1	0.0	67.5	0.0	22.5	0	0.0	22.5	67.5	0.0
349	2	15	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
350	2	15	0	4	3	3	0.0	0.0	30.0	0.0	0	10.0	0.0	0.0	40.0
351	2	15	0	4	.	.	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0
352	2	15	0	4	3	.	0.0	0.0	100.0	0.0	0	0.0	0.0	0.0	100.0

SUBSTRATE

What I would like to do is recode using the modified Wentworth Scale Substrate Classification and place our observations as best we can into the following:

THE CODE	Classification	Size (mm)	Include old codes
0	ORGANICS	MISC. ORGAN. DEBRIS	11, 15, 17, 18
1	CLAY	< 0.004	10
2	SILT	0.004 - 0.062	1, 7, 13, 16, 19, 21, 24
3	SAND	0.062 - 1	2
4	COARSE SAND	1 - 2	
5	GRANULE	2 - 4	20
6	SM. GRAVEL	4 - 8	8
7	MED. GRAVEL	8 - 16	3, 23
8	LG. GRAVEL	16 - 32	—
9	RUBBLE	32 - 64	
10	SM. COBBLE	64 - 128	4, 5
11	LG. COBBLE	128 - 256	
12	SM. BOULDER	256 - 512	6, 22
13	MED. BOULDER	512 - 1024	—
14	LG. BOULDER	> 1024	
15	BEDROCK	SOLID SUBSTRATE	12, 14

None of the following substrate codes should be used:

16, 17, 18, 19, 20, 21, 22, 23, 24

I place plant debris, leaf litter, and misc. plant detritus in # 0 = organics.
I place mud, fines, in # 2 = silt.
I place all sand in # 3 = sand.
I place gravel in # 7 = med. gravel (unless more specific info. was recorded).
I place cobble in # 10 = small cobble
I place all boulders in # 12 = small boulders

I place concrete in # 15 = bedrock, (I believe all references on data sheet refer to smooth concrete (Comal section 10 comes to mind). If it was clastic, it should have been recorded in the field as boulders or whatever size)

In the future, forms should be filled out with the modified Wentworth.

HABITAT TYPES

mod = moderate.

THE CODE	HABITAT TYPE
1	backwater
2	run
3	eddy
4	fast run
5	slow run
6	back eddy
7	moderate run
8	edge
9	riffle
10	pool
11	side channel
12	fast, clear water [probably fast run]
13	springrun

Plants and Algae

THE CODE	8-character scientif DATACODE	OLD CODE(S)	DESCRIPTION OF VEGETATION
1	ludwigia	1, 22, 42	water primrose, Ludwigia repens
2	charaspp	2	chara species
3	ricciafl	3, 54	riccia, Riccia fluitans
4	egeriade	4	waterweed, Egeria densa
5	vallisne	5, 34, 36	wild celery, Vallisneria americana
6	nupharlu	6, 20, 23, 26, 47	yellow cow lily, Nuphar luteum
7	rhyzoclo	7, 27	filamentous algae, Rhyzoclonium sp. et al.
8	cabombac	8, 21	fanwort, Cabomba caroliniana
9	bryophyt	9, 48	unidentified moss, bryophyte
10	utricula	10	bladderwort, Utricularia gibba
12	ceratopt	12, 25, 28, 43, 44	water sprite, Ceratopteris thalictroides
13	hydrilla	13	hydrilla, Hydrilla verticillata
14	potamoge	14, 35, 38	pondweed, Potamogeton sp.
15	typhaspp	15	cat-tail, Typha sp.
16	sagittar	16, 39, 58	delta arrow-head, Sagittaria platyphyla
17	justicia	17, 45	water willow, Justicia americana
18	myriophy	18	water-milfoil Myriophyllum brasiliense et al.
19	hydrocot	19, 49	water-pennywort, Hydrocotyle sp.
24	amblyste	24, 29	amblystegium, Amblystegium riparium
30	algaespp	30, 33, 50, 52, 56	algae, various species, usu. attached
31	eleochar	31, 40, 53	spikerush, Eleocharis sp.
32	nasturti	32	watercress, N. officinale (= Rorippa n-aquaticum)
37	grassspp	37	unidentified grass
41	colocasi	41, 46	elephant ear, Colocasia esculenta
51	polygonu	51	smartweed, Polygonum spp.
55	irissspp	55	unidentified iris/flag

None of the following plant codes should be used: 33, 40, 50, 52, 56, 57, 60

(3) Fishes and Invertebrates;

THE CODE	FISH/invertebrate NAME	OLD CODE(s)
1	FOUNTAIN DARTER	1
2	UNIDENTIFIED GAMBUSIA	2, 30
3	LARGESPRING GAMBUSIA	3
4	MOSQUITOFISH	4
5	SAILFIN MOLLY	5
6	ROCK BASS	6
7	SPOTTED SUNFISH	7
8	ROUNDNOSE MINNOW	8, 24
9	LARGEMOUTH BASS	9
10	UNIDENTIFIED SUNFISH SP.	10, 15, 16, 17, 36, 60
11	RIO GRANDE CICHLID	11, 41
12	GREENTHROAT DARTER	12
13	MEXICAN TETRA	13
14	WARMOUTH	14
18	UNIDENTIFIED ETHEOSTOMA	18, 49
19	YELLOW BULLHEAD	19
20	EURYCEA SP.	20
21	CRAYFISH	21, 42, 43, 46
22	ODONATE NYMPHS	22
23	GREEN SUNFISH	23
25	BLUEGILL	25
26	LONGEAR SUNFISH	26
27	TEXAS SHINER	27
28	MIMIC SHINER	28
29	REDBREAST SUNFISH	29, 60
31	UNIDENTIFIED FISH	31, 61
32	UNIDENTIFIED MINNOW	32, 47, 52, 54
33	UNIDENTIFIED MICROPTERIS SP.	33, 58
34	UNIDENTIFIED CICHLID SP.	34
35	TADPOLE	35

HE CODE	FISH/invertebrate NAME	OLD CODE(s)
37	GUADALUPE BASS	37
38	REDEAR SUNFISH	38
39	ORANGETHROAT DARTER	39
40	WEED SHINER	40
44	GLASS SHRIMP	44
45	TURTLE	45
48	BIVALVES	48
50	GIANT RAMSHORN SNAIL	50
51	BLACK BULLHEAD	51
53	SMALLMOUTH BASS	53
56	UNIDENTIFIED BULLHEAD SP.	56
57	STINKPOT	57
59	UNIDENTIFIED TILAPIA SP.	59
62	GIANT RAMSHORN SNAIL EGGS	62, 64
63	UNIDENTIFIED CATFISH	63
66	THIARA GRANIFERA	
67	THIARA TUBERCULATA	

None of the following fish/invertebrate codes should be used:
15, 16, 17, 24, 30, 36, 41, 42, 43, 46, 47, 49, 52, 54, 55, 58, 60, 61, 64, 65.

THERE SHOULD BE NO SAMPLES WITH

	fish name	old code
Menidia beryllina	MENDIA - B	55
	redthroat sunfish	60
	brown bullhead	65

Please identify Section, cell, and date of sample if these pop up.

APPENDIX 3

PERIOD.SAS

```
libname lib 'c:\saswork';
data lib.july;
infile 'c:\saswork\july.dat' pad;
input strata$ 1-5 grid$ 9-15 perveg 17-19 domveg 25-26 SUBVEG 33-34
PERDV 41-46 PERSV 49-53 TEMP 57-62 DO 65-70 PH 73-76 SC 81-85 DEPTH 89-93
VBOT 97-101 VAVG 105-109 numspec 113-114 numpass 121-122 darter 129-130;
run;

data july; set lib.july;
period=1;
run;

libname lib 'c:\saswork';
data lib.OCT;
infile 'c:\saswork\oct.dat' pad;
input strata$ 1-5 grid$ 9-15 perveg 17-19 domveg 25-26 SUBVEG 33-34
PERDV 41-46 PERSV 49-53 TEMP 57-62 DO 65-70 PH 73-76 SC 81-85 DEPTH 89-93
VBOT 97-101 VAVG 105-109 numspec 113-114 numpass 121-122 darter 129-130;
run;

data oct; set lib.oct;
period=2;
run;

libname lib 'c:\saswork';
data lib.jan;
infile 'c:\saswork\jan.dat' pad;
input strata$ 1-5 grid$ 9-15 perveg 17-19 domveg 25-26 SUBVEG 33-34
PERDV 41-46 PERSV 49-53 TEMP 57-62 DO 65-70 PH 73-76 SC 81-85 DEPTH 89-93
VBOT 97-101 VAVG 105-109 numspec 113-114 numpass 121-122 darter 129-130;
run;

data jan; set lib.jan;
period=3;
run;

libname lib 'c:\saswork';
data lib.april;
infile 'c:\saswork\april.dat' pad;
input strata$ 1-5 grid$ 9-15 perveg 17-19 domveg 25-26 SUBVEG 33-34
PERDV 41-46 PERSV 49-53 TEMP 57-62 DO 65-70 PH 73-76 SC 81-85 DEPTH 89-93
VBOT 97-101 VAVG 105-109 numspec 113-114 numpass 121-122 darter 129-130;
run;
```

```
data april; set lib.april;
period=4;
run;

data all;
set july oct jan april;
run;

data vegcls; set all;
if domveg=1 then dvegcls=3;
if domveg=2 then dvegcls=3;
if domveg=3 then dvegcls=1;
if domveg=5 then dvegcls=2;
if domveg=6 then dvegcls=3;
if domveg=7 then dvegcls=1;
if domveg=8 then dvegcls=1;
if domveg=9 then dvegcls=1;
if domveg=10 then dvegcls=1;
if domveg=12 then dvegcls=3;
if domveg=14 then dvegcls=3;
if domveg=16 then dvegcls=2;
if domveg=17 then dvegcls=3;
if domveg=19 then dvegcls=3;
if domveg=24 then dvegcls=1;
if domveg=30 then dvegcls=1;
if domveg=31 then dvegcls=3;
if domveg=32 then dvegcls=3;
if domveg=51 then dvegcls=3;
if subveg=1 then svegcls=3;
if subveg=2 then svegcls=3;
if subveg=3 then svegcls=1;
if subveg=5 then svegcls=2;
if subveg=6 then svegcls=3;
if subveg=7 then svegcls=1;
if subveg=8 then svegcls=1;
if subveg=9 then svegcls=1;
if subveg=10 then svegcls=1;
if subveg=12 then svegcls=3;
if subveg=14 then svegcls=3;
if subveg=16 then svegcls=2;
if subveg=17 then svegcls=3;
if subveg=19 then svegcls=3;
if subveg=24 then svegcls=1;
if subveg=30 then svegcls=1;
if subveg=31 then svegcls=3;
```

```
if subveg=32 then svegcls=3;
if subveg=37 then svegcls=3;
if subveg=41 then svegcls=3;
if subveg=51 then svegcls=3;
if subveg=55 then svegcls=3;
run;

data percls; set vegcls;
if dvegcls=1 then dcom1=perdv;
else dcom1=0;
if dvegcls=2 then dcom2=perdv;
else dcom2=0;
if dvegcls=3 then dcom3=perdv;
else dcom3=0;
if svegcls=1 then scom1=persv;
else scom1=0;
if svegcls=2 then scom2=persv;
else scom2=0;
if svegcls=3 then scom3=persv;
else scom3=0;
run;

data lib.final; set percls;
vegcom1=dcom1+scom1;
vegcom2=dcom2+scom2;
vegcom3=dcom3+scom3;
run;

data lib.final; set lib.final;
  if strata=2 then delete;
  if strata=6 then delete;
proc print;
run;


proc univariate data=lib.final plot;
var ph depth temp do sc vbot vavg darter vegcom1 vegcom2 vegcom3;
run;
```

NORM.SAS

```
libname lib 'c:\saswork';
data work1; set lib.final;
if darter=0 then present=0;
else present=1;
run;

data july; set work1;
if period=1;
run;

data oct; set work1;
if period=2;
run;

data jan; set work1;
if period=3;
run;

data april; set work1;
if period=4;
run;

data july2; set july;
tempcube=temp**3;
logdo=log10(do);
ncubesc=-sc**-3;
logvnos=log10(vbot);
logvavg=log10(vavg);
rtvc1=sqrt((vegcom1)/100);
rtvc2=sqrt((vegcom2)/100);
rtvc3=sqrt((vegcom3)/100);
run;

data july3; set july2;
tranvc1=arsin(rtvc1);
tranvc2=arsin(rtvc2);
tranvc3=arsin(rtvc3);
run;


data oct2; set oct;
tempcube=temp**3;
```

```
logdo=log10(do);
ncubesc=-sc**-3;
logvnos=log10(vbot);
logvavg=log10(vavg);
rtvc1=sqrt((vegcom1)/100);
rtvc2=sqrt((vegcom2)/100);
rtvc3=sqrt((vegcom3)/100);
run;

data oct3; set oct2;
tranvc1=arsin(rtvc1);
tranvc2=arsin(rtvc2);
tranvc3=arsin(rtvc3);
run;

data jan2; set jan;
tempcube=temp**3;
logdo=log10(do);
ncubesc=-sc**-3;
logvnos=log10(vbot);
logvavg=log10(vavg);
rtvc1=sqrt((vegcom1)/100);
rtvc2=sqrt((vegcom2)/100);
rtvc3=sqrt((vegcom3)/100);
run;

data jan3; set jan2;
tranvc1=arsin(rtvc1);
tranvc2=arsin(rtvc2);
tranvc3=arsin(rtvc3);
run;

data april2; set april;
tempcube=temp**3;
logdo=log10(do);
ncubesc=-sc**-3;
logvnos=log10(vbot);
logvavg=log10(vavg);
rtvc1=sqrt((vegcom1)/100);
rtvc2=sqrt((vegcom2)/100);
rtvc3=sqrt((vegcom3)/100);
run;

data april3; set april2;
tranvc1=arsin(rtvc1);
```

```
tranvc2=arsin(rtvc2);
tranvc3=arsin(rtvc3);
run;

data work2; set work1;
ncubesc=-sc**-3;
tempcube=temp**3;
logdo=log10(do);
logvnos=log10(vbot);
logvavg=log10(vavg);
rtvc1=sqrt((vegcom1)/100);
rtvc2=sqrt((vegcom2)/100);
rtvc3=sqrt((vegcom3)/100);
run;

data lib.tcomal; set work2;
tranvc1=arsin(rtvc1);
tranvc2=arsin(rtvc2);
tranvc3=arsin(rtvc3);
run;

proc univariate data=july3 normal plot;
var ph depth tranvc1 tranvc2 tranvc3 tempcube logdo
ncubesc logvnos logvavg;
run;



proc univariate data=oct3 normal plot;
var ph depth tranvc1 tranvc2 tranvc3 tempcube logdo
ncubesc logvnos logvavg;
run;

proc univariate data=jan3 normal plot;
var ph depth tranvc1 tranvc2 tranvc3 tempcube logdo
ncubesc logvnos logvavg;
run;

proc univariate data=april3 normal plot;
var ph depth tranvc1 tranvc2 tranvc3 tempcube logdo
ncubesc logvnos logvavg;
run;

proc univariate data=lib.tcomal normal plot;
var ph depth tranvc1 tranvc2 tranvc3 tempcube logdo
```

```
ncubesc logvnos logvavg;
run;
```

DISCRIM.SAS

```
libname lib 'c:\saswork';
proc princomp data=lib.tcomal out=out outstat=stat n=5;
 var ph depth tempcube logdo ncubesc logvnos logvavg tranvc1
 tranvc2 tranvc3;
run;

proc print data=stat;
run;

proc glm data=out;
 class period;
 model prin1 prin2 prin3 prin4 prin5=period;
means period/regwq;
run;

proc glm data=lib.tcomal;
 class period;
 model ph depth tempcube logdo ncubesc logvnos logvavg tranvc1
 tranvc2 tranvc3=period;
means period/regwq;
run;

proc princomp data=lib.tcomal out=prin outstat=stat n=5;
 var ph depth tempcube logdo ncubesc logvnos logvavg tranvc1
 tranvc2 tranvc3;
by period;
run;
proc print data=stat;
run;

data lib.prinjul; set prin;
if period=1;
run;

data lib.prinoct; set prin;
if period=2;
run;

data lib.prinjan; set prin;
if period=3;
run;

data lib.prinapr; set prin;
```

```
if period=4;
run;

proc stepdisc data=lib.prinjul slentry=0.10;
var ph depth tempcube logdo ncubesc logvavg logvnos tranvc1 tranvc2 tranvc3;
class present;
run;

proc stepdisc data=lib.prinoct slentry=0.10;
var ph depth tempcube logdo ncubesc logvavg logvnos tranvc1 tranvc2 tranvc3;
class present;
run;

proc stepdisc data=lib.prinjul slentry=0.10;
var prin1 prin2 prin3 prin4 prin5;
class present;
run;

proc stepdisc data=lib.prinoct slentry=0.10;
var prin1 prin2 prin3 prin4 prin5;
class present;
run;

proc discrim data=lib.prinjul outstat=dart1 method=normal all;
priors proportional;
class present;
var logvnos;
run;

proc discrim data=lib.prinjul outstat=dart2 method=normal all;
priors proportional;
class present;
var prin2 prin1;
run;

proc discrim data=lib.prinoct outstat=dart3 method=normal all;
priors proportional;
class present;
var logvavg tranvc3 tranvc1 ph;
run;

proc discrim data=lib.prinoct outstat=dart4 method=normal all;
priors proportional;
class present;
var prin1 prin2 prin3;
```

```
run;
```

STEPWISE.SAS

```
libname lib 'c:\saswork';
data sortjul1; set lib.prinjul;
no=-1.71631-2.22288*logvnos;
yes=-3.41506-4.34324*logvnos;
logdart=log10(darter+1);
run;

data sortjul2; set sortjul1;
 if present=0;
run;

data sortjul4; set sortjul1;
  if present=1;
run;

data sortjul3; set sortjul2;
if yes GE no then fish=1;
 else fish=0;
run;

data sortjul5; set sortjul3;
if fish=1;
run;

data sortjul6;
set sortjul5 sortjul4;
run;


proc univariate data=sortjul1 normal plot;
var logdart;
run;

proc stepwise data=sortjul1;
  model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;

proc stepwise data=sortjul6;
 model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;

data nozero; set sortjul1;
if present > 0;
```

```
run;

proc stepwise data=nozero;
 model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;


data sortjp1; set lib.prinjul;
no=-1.16546+0.38529*prin2+0.28096*prin1;
yes=-0.56752-0.24080*prin2-0.17560*prin1;
logdart=log10(darter+1);
run;

data sortjp2; set sortjp1;
 if present=0;
run;

data sortjp4; set sortjp1;
  if present=1;
run;

data sortjp3; set sortjp2;
if yes GE no then fish=1;
 else fish=0;
run;

data sortjp5; set sortjp3;
if fish=1;
run;

data sortjp6;
set sortjp5 sortjp4;
run;

proc stepwise data=sortjp1;
  model logdart=prin1 prin2 prin3 prin4 prin5;
run;

proc stepwise data=sortjp6;
 model logdart=prin1 prin2 prin3 prin4 prin5;
run;

data jpzero; set sortjp1;
if present > 0;
run;
```

```
proc stepwise data=jpzero;
 model logdart=prin1 prin2 prin3 prin4 prin5;
run;

data sortoct1; set lib.prinoct;
no=-531.24866+7.33288*logvavg-7.60364*tranvc3-2.78356*tranvc1
+144.95059*ph;
yes=-518.76194+7.35256*logvavg-5.54641*tranvc3+.00135*tranvc1
+143.01975*ph;
logdart=log10(darter+1);
run;

data sortoct2; set sortoct1;
 if present=0;
run;

data sortoct4; set sortoct1;
  if present=1;
run;

data sortoct3; set sortoct2;
if yes GE no then fish=1;
 else fish=0;
run;

data sortoct5; set sortoct3;
if fish=1;
run;

data sortoct6;
set sortoct5 sortoct4;
run;


proc univariate data=sortoct1 normal plot;
var logdart darter;
run;

proc stepwise data=sortoct1;
  model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;

proc stepwise data=sortoct6;
 model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;
```

```
data octzero; set sortoct1;
if present > 0;
run;

proc stepwise data=octzero;
 model logdart=depth ph vegcom1 vegcom2 vegcom3 vbot vavg sc temp do;
run;


data sortop1; set lib.prinoct;
no=-0.85760+0.15576*prin1+0.45401*prin2+0.31640*prin3;
yes=-.95972-0.16730*prin1-0.48764*prin2-0.33984*prin3;
logdart=log10(darter+1);
run;

data sortop2; set sortop1;
 if present=0;
run;

data sortop4; set sortop1;
  if present=1;
run;

data sortop3; set sortop2;
if yes GE no then fish=1;
 else fish=0;
run;

data sortop5; set sortop3;
if fish=1;
run;

data sortop6;
set sortop5 sortop4;
run;

proc stepwise data=sortop1;
  model logdart=prin1 prin2 prin3 prin4 prin5;
run;

proc stepwise data=sortop6;
 model logdart=prin1 prin2 prin3 prin4 prin5;
run;

data opzero; set sortop1;
```

```
if present > 0;
run;

proc stepwise data=opzero;
 model logdart=prin1 prin2 prin3 prin4 prin5;
run;
```

REGTEST.SAS

```
libname lib 'c:\SASWORK';
data sortjul1; set lib.prinjul;
no=-1.71631-2.22288*logvnos;
yes=-3.41506-4.34324*logvnos;
logdart=log10(darter+1);
run;


proc reg data=sortjul1;
  model logdart=vbot vegcom1 vegcom3 temp;
 run;

data julfin; set sortjul1;

predict=2.845638-0.259062*vbot+.008261*vegcom1+.004394*vegcom3-.099353*temp;
run;

proc reg data=julfin;
model logdart=predict / noint;
run;

data aprilfin; set lib.prinapr;
no=-1.71631-2.22288*logvnos;
yes=-3.41506-4.34324*logvnos;
logdart=log10(darter+1);

predict=2.845638-0.259062*vbot+.008261*vegcom1+.004394*vegcom3-.099353*temp;
run;


proc reg data=aprilfin;
 model logdart=predict / noint;
run;

data summer; set julfin aprilfin;
run;

proc glm data=summer;
class period;
model logdart=period predict period*predict;
means period/regwq;
run;
```

```
data sortjp1; set lib.prinjul;
no=-1.16546+0.38529*prin2+0.28096*prin1;
yes=-0.56752-0.24080*prin2-0.17560*prin1;
logdart=log10(darter+1);
run;

proc reg data=sortjp1;
 model logdart=prin2 prin1 prin5;
run;

data julfinp; set sortjp1;
predict=.533741-.121682*prin3-.093519*prin1-.115021*prin5;
run;

proc reg data=julfinp;
model logdart=predict / noint;
run;

data aprilfp; set lib.prinapr;
no=-1.16546+0.38529*prin2+0.28096*prin1;
yes=-0.56752-0.24080*prin2-0.17560*prin1;
logdart=log10(darter+1);
predict=.533741-.121682*prin3-.093519*prin1-.115021*prin5;
run;



proc reg data=aprilfp;
 model logdart=predict / noint;
run;

data summerp; set julfinp aprilfp;
run;

proc glm data=summerp;
class period;
model logdart=period predict period*predict;
means period/regwq;
run;


data sortoct1; set lib.prinoct;
logdart=log10(darter+1);
run;
```

```
proc reg data=sortoct1;
 model logdart=vbot vegcom1 vegcom3;
run;

data octfin; set sortoct1;
predict=.13866-.280402*vbot+.008144*vegcom1+.004486*vegcom3;
run;

proc reg data=octfin;
model logdart=predict / noint;
run;

data janfin; set lib.prinjan;
logdart=log10(darter+1);
predict=.13866-.280402*vbot+.008144*vegcom1+.004486*vegcom3;
run;


proc reg data=janfin;
 model logdart=predict / noint;
run;


data fall; set octfin janfin;
run;

proc glm data=fall;
class period;
model logdart=period predict period*predict;
means period/regwq;
run;


data sortop1; set lib.prinoct;
logdart=log10(darter+1);
run;

proc reg data=sortop1;
 model logdart=prin1 prin3 prin4 prin2;
run;


data octfinp; set sortop1;
predict=.277441-.069066*prin1-.072763*prin3+.088007*prin4-.092371*prin2;
run;
```

```
proc reg data=octfinp;
model logdart=predict / noint;
run;

data janfinp; set lib.prinjan;
logdart=log10(darter+1);
predict=.277441-.069066*prin1-.072763*prin3+.088007*prin4-.092371*prin2;
run;


proc reg data=janfinp;
 model logdart=predict / noint;
run;

data fallprin;  set octfinp janfinp;
run;

proc glm data=fallprin;
class period;
model logdart=period predict period*predict;
means period/regwq;
run;


data allcont; set summer fall;
run;

proc glm data=allcont;
class period;
model logdart=period;
means period/regwq;
run;


proc reg data=sortjul1;
  model logdart=vbot vegcom1 vegcom3 /collin;
  output out=work
  r=resid
  p=predict;
run;

proc univariate data=work normal plot;
var resid;
run;
```

```
proc plot data=work;
plot resid*predict;
run;
```

DFATEST.SAS

```
libname lib 'c:\SASWORK';
data sortjul1; set lib.prinjul;
no=-1.71631-2.22288*logvnos;
yes=-3.41506-4.34324*logvnos;
logdart=log10(darter+1);
run;

data juldfa; set sortjul1;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=juldfa;
var strata grid present dfapred;
run;

data aprilfin; set lib.prinapr;
no=-1.71631-2.22288*logvnos;
yes=-3.41506-4.34324*logvnos;
logdart=log10(darter+1);

predict=2.845638-0.259062*vbot+.008261*vegcom1+.004394*vegcom3-.099353*temp;
run;

data aprildfa; set aprilfin;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=aprildfa;
var strata grid present dfapred;
run;


data sortjp1; set lib.prinjul;
no=-1.16546+0.38529*prin2+0.28096*prin1;
yes=-0.56752-0.24080*prin2-0.17560*prin1;
logdart=log10(darter+1);
run;

data juldfap; set sortjp1;
if no>yes then dfapred=0; else dfapred=1;
run;
```

```
proc print data=juldfap;
var strata grid present dfapred;
run;

data aprilfp; set lib.prinapr;
no=-1.16546+0.38529*prin2+0.28096*prin1;
yes=-0.56752-0.24080*prin2-0.17560*prin1;
logdart=log10(darter+1);
predict=.533741-.121682*prin3-.093519*prin1-.115021*prin5;
run;

data aprdfap; set aprilfp;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=aprdfap;
var strata grid present dfapred;
run;


data sortoct1; set lib.prinoct;
no=-531.24866+7.33288*logvavg-7.60364*tranvc3-2.78356*tranvc1
+144.95059*ph;
yes=-518.76194+7.35256*logvavg-5.54641*tranvc3+.00135*tranvc1
+143.01975*ph;
logdart=log10(darter+1);
run;

data octdfa; set sortoct1;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=octdfa;
var strata grid present dfapred;
run;

data janfin; set lib.prinjan;
no=-531.24866+7.33288*logvavg-7.60364*tranvc3-2.78356*tranvc1
+144.95059*ph;
yes=-518.76194+7.35256*logvavg-5.54641*tranvc3+.00135*tranvc1
+143.01975*ph;
logdart=log10(darter+1);
```

```
run;

data jandfa; set janfin;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=jandfa;
var strata grid present dfapred;
run;

data sortop1; set lib.prinoct;
no=-0.85760+0.15576*prin1+0.45401*prin2+0.31640*prin3;
yes=-.95972-0.16730*prin1-0.48764*prin2-0.33984*prin3;
logdart=log10(darter+1);
run;

data octdfap; set sortop1;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=octdfap;
var strata grid present dfapred;
run;

data janfinp; set lib.prinjan;
no=-0.85760+0.15576*prin1+0.45401*prin2+0.31640*prin3;
yes=-.95972-0.16730*prin1-0.48764*prin2-0.33984*prin3;
logdart=log10(darter+1);
run;


data jandfap; set janfinp;
if no>yes then dfapred=0; else dfapred=1;
run;


proc print data=jandfap;
var strata grid present dfapred;
run;
```